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VOL. XV. PLA——RAN

INDOCTI DISCANT, ET AMENT MEMINISSE PERITI.

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BRITISH MUSEUM

ENCYCLOPÆDIA.

PLANT is defined to be, an organical body, deſtitute of ſenſe and ſpontaneous motion adhering to another body in ſuch a manner as to draw from it its nouriſhment, and having a power of propagating itſelf by ſeeds.

The vegetation and economy of plants is one of thoſe ſubjects in which our knowledge is extremely circumſcribed. A total inattention to the ſtructure and economy of plants is the chief reaſon of the ſmall progreſs that has been made in the principles of vegetation, and of the inſtability and fluctuation of our theories concerning it; for which reaſon we ſhall give a ſhort deſcription of the ſtructure of plants, beginning with the ſeed, and tracing its progreſs and evolution to a ſtate of maturity.

1. *Of Seeds.*] The ſeeds of plants are of various figures and ſizes. Moſt of them are divided into two lobes; though ſome, as thoſe of the creſs-kind, have ſix; and others, as the grains of corn, are not divided, but entire.

But as the eſſential properties of all ſeeds are the ſame, when conſidered with regard to the principles of vegetation, our particular deſcriptions ſhall be limited to one ſeed, viz the great garden-bean. Neither is the choice of this ſeed altogether arbitrary; for, after it begins to vegetate, its parts are more conſpicuous than many others, and conſequently better calculated for inveſtigation.

Plate CCCXCIV.

This ſeed is covered with two coats or membranes. The outer coat is extremely thin, and full of pores; but may be eaſily ſeparated from the inner one (which is much thicker), after the bean has been boiled, or lain a few days in the ſoil. At the thick end of the bean there is a ſmall hole viſible to the naked eye, immediately over the radicle or future root, that it may have a free paſſage into the ſoil (fig. 1. A). When theſe coats are taken off, the body of the ſeed appears, which is divided into two ſmooth portions or lobes. The ſmoothneſs of the lobes is owing to a thin film or cuticle with which they are covered.

Plate CCCXCI.

At the baſis of the bean is placed the radicle, or future root (fig. 3, A). The trunk of the radicle, juſt as it enters into the body of the ſeed, divides into two capital branches, one of which is inſerted into each lobe, and ſends off ſmaller ones in all directions through the whole ſubſtance of the lobes (fig. 4. AA). Theſe ramifications become ſo extremely minute towards the edges of the lobes, that they require the fineſt glaſſes to render them viſible. To theſe ramifications Grew and Malpighi have given the name of *ſeminal root*; becauſe by means of it, the radicle and plume, before they are expanded, derive their principal nouriſhment.

Plate CCCXCIV.

The plume, bud, or germ (fig. 3.), is incloſed in two ſmall correſponding cavities in each lobe. Its colour and conſiſtence is much the ſame with thoſe of the radicle, of which it is only a continuation, but having a quite contrary direction; for the radicle deſcends into the earth, and divides into a great number of ſmaller branches or filaments but the plume aſcends into the open air, and unfolds itſelf into all the beautiful variety of ſtem, branches, leaves, flowers, fruit, &c. The plume in corn ſhoots from the ſmaller end of the grain, and among maltſters goes by the name of *acroſpire*.

The next thing to be taken notice of is the ſubſtance or parenchymatous part of the lobes. This is not a mere concreted juice, but is curiouſly organized, and conſiſts of a vaſt number of ſmall bladders reſembling thoſe in the pith of trees (fig. 4.)

Plate CCCXCI.

Beſides the coats, cuticle, and parenchymatous parts, there is a ſubſtance perfectly diſtinct from theſe, diſtributed in different proportions through the radicle, plume, and lobes. This inner ſubſtance appears very plainly in a tranſverſe ſection of the radicle or plume. Towards the extremity of the radicle it is one entire trunk; but higher up it divides into three branches; the middle one runs directly up to the plume, and the other two paſs into the lobes on each ſide, and ſpread out into a great variety of ſmall branches through the whole body of the lobes (fig. 4.) This ſubſtance is very properly termed the *ſeminal root*; for when the ſeed is ſown, the moiſture is firſt abſorbed by the outer coats, which are everywhere furniſhed with ſap and air veſſels; from theſe it is conveyed to the cuticle; from the cuticle it proceeds to the pulpy part of the lobes; when it has got thus far, it is taken up by the mouths of the ſmall branches of the ſeminal root, and paſſes from one branch into another, till it is all collected into the main trunk, which communicates both with the plume and radicle, the two principal involved organs of the future plant. After this the ſap or vegetable food runs in two oppoſite directions: part of it aſcends into the plume, and promotes the growth and expanſion of that organ; and part of it deſcends into the radicle, for nouriſhing and evolving the root and its various filaments. Thus the plume and radicle continue their progreſs in oppoſite directions till the plant arrives at maturity.

It is here worth remarking, that every plant is really poſſeſſed of two roots, both of which are contained in the ſeed. The plume and radicle when the ſeed is firſt depoſited in the earth, derive their nouriſhment from the ſeminal root; but afterwards, when the radicle begins to ſhoot out its filaments and to abſorb ſome moiſture, not, however, in a ſufficient quantity to ſupply the exigencies of the plume, the two lobes, or main body of the ſeed, riſe along with the plume, aſſume the appearance of two leaves, reſembling the lobes of the ſeed in ſize and ſhape, but having no reſemblance to thoſe of the plume, for which reaſon they have got the name of *diſſimilar leaves*.

Theſe diſſimilar leaves defend the young plume from the injuries of the weather, and at the ſame time, by abſorbing dew, air, &c. aſſiſt the tender radicle in nouriſhing the plume, with which they have ſtill a connection by means of the ſeminal root above deſcribed. But when the radicle or ſecond root has deſcended deep enough into the earth, and has acquired a ſufficient number of filaments or branches for abſorbing as much aliment as is proper for the growth of the plume; then the ſeminal or diſſimilar leaves, their utility being entirely ſuperſeded, begin to decay and fall off.

Plate cccxciv. Fig. I. A, the foramen or hole in the bean through which the radicle ſhoots into the ſoil.

Fig. 2. A, a tranſverſe ſection of the bean; the dots being the branches of the ſeminal root.

Fig. 3. A, the radicle. B, the plume or bud.

Fig. 4. A, a longitudinal ſection of one of the lobes of the bean a little magnified, to ſhow the ſmall bladders of which the pulpy or parenchymatous part is compoſed.

Figs. 5. 6. A, a tranſverſe ſection of the radicle. B, a tranſverſe ſection of the plume, ſhowing the organs or veſſels of the ſeminal root.

Plate cccxci. Fig. 4. A view of the ſeminal root branched out upon the lobes.

Plate cccxciv. Fig. 7. The appearance of the radicle, plume, and ſeminal root, when a little further advanced in growth.

Having thus briefly deſcribed the ſeed, and traced its evolution into three principal organic parts, viz. the plume, radicle, and ſeminal leaves, we ſhall next take an anatomical view of the root, trunk, leaves, &c.

2. *Of the root.* In examinining the root of plants, the firſt thing that preſents itſelf is the ſkin which is of various colours in different plants. Every root, after it has arrived at a certain age, has a double ſkin. The firſt is coeval with the other parts, and exiſts in the ſeed: but afterwards there is a ring ſent off from the bark, and forms a ſecond ſkin; *e. g.* in the root of the dandelion, towards the end of May, the original or outer ſkin appears ſhrivelled, and is eaſily ſeparated from the new one, which is freſher, and adheres more firmly to the bark. Perennial plants are ſupplied in this manner with a new ſkin every year; the outer one always falls off in the autumn and winter, and a new one is formed from the bark in the ſucceeding ſpring. The ſkin has numerous cells or veſſels, and is a continuation of the parenchymatous part of the radicle. However, it does not conſiſt ſolely of parenchyma; for the microſcope ſhows that there are many tubular ligneous veſſels interſperſed through it.

When the ſkin is removed, the true cortical ſubſtance or bark appears, which is alſo a continuation of the parenchymatous part of the radicle, but greatly augmented. The bark is of very different ſizes. In moſt trees it is exceeding thin in proportion to the wood and pith. On the other hand, in carrots, it is almoſt one-half of the ſemidiameter of the root; and, in dandelion, it is nearly twice as thick as the woody part.

The bark is compoſed of two ſubſtances; the parenchyma or pulp, which is the principal part, and a few woody fibres. The parenchyma is exceedingly porous, and has a great reſemblance to a ſponge; for it ſhrivels conſiderably when dried, and dilates to its former dimenſions when infuſed in water. Theſe pores or veſſels are not pervious, ſo as to communicate with each other; but conſiſt of diſtinct little cells or bladders, ſcarcely viſible without the aſſiſtance of the microſcope. In all roots, theſe cells are conſtantly filled with a thin watery liquor. They are generally of a ſpherical figure; though in ſome roots, as the bugloſs and dandelion, they are oblong. In many roots, as the horſe-radiſh, peony, aſparagus, potatoe, &c. the parenchyma is of one uniform ſtructure. But in others it is more diverſified, and puts on the ſhape of rays, running from the centre towards the circumference of the bark. Theſe rays ſometimes run quite through the bark, as in lovage; and ſometimes advance towards the middle of it, as in melilot and moſt of the leguminous and umbelliferous plants. Theſe rays generally ſtand at an equal diſtance from each other in the ſame plant; but the diſtance varies greatly in different plants. Neither are they of equal ſizes: in carrot they are exceedingly ſmall, and ſcarcely diſcernible; in melilot and chervil, they are thicker. They are likewiſe more numerous in ſome plants than in others. Sometimes they are of the ſame thickneſs from one edge of the bark to the other; and ſome grow wider as they approach towards the ſkin. The veſſels with which theſe rays are amply furniſhed, are ſuppoſed to be air-veſſels, becauſe they are always found to be dry, and not ſo tranſparent as the veſſels which evidently contain the ſap.

In all roots there are ligneous veſſels diſperſed in different proportions through the parenchyma of the bark. Theſe ligneous veſſels run longitudinally through the bark in the form of ſmall threads, which are tubular, as is evident from the riſing of the ſap in them when a root is cut tranſverſely. Theſe ligneous ſap-veſſels do not run in direct lines through the bark, but at ſmall diſtances incline towards one another, in ſuch a manner that they appear to the naked eye to be inoſculated; but the microſcope diſcovers them to be only contiguous, and braced together by the parenchyma. Theſe braces or coarctations are very various both in ſize and number in different roots; but in all plants they are moſt numerous towards the inner edge of the bark. Neither are theſe veſſels ſingle tubes; but, like the nerves in animals, are bundles of 20 or 30 ſmall contiguous cylindrical tubes, which uniformly run from the extremity of the root, without ſending off any branches or ſuffering any change in their ſize or ſhape.

In ſome roots, as parſnep, eſpecially in the ring next the inner extremity of the bark, theſe veſſels contain a kind of lymph, which is ſweeter than the ſap contained in the bladders of the parenchyma. From this circumſtance they have got the name of *lymph-ducts*.

Theſe lymph-ducts ſometimes yield a mucilaginous lymph, as in the comphrey; and ſometimes a white milky glutinous lymph, as in the angelica, ſonchus, burdock, ſcorzonera, dandelion, &c. The lymph-ducts are ſuppoſed to be the veſſels from which the gums and balſams are ſecerned. The lymph of fennel, when expoſed to the air, turns into a clear tranſparent balſam; and that of the ſcorzonera, dandelion, &c. condenſes into a gum.

The ſituation of the veſſels is various. In ſome plants they ſtand in a ring or circle at the inner edge of the bark, as in aſparagus; in others, they appear in lines or rays, as in borage; in the parſnep, and ſeveral other plants, they are moſt conſpicuous towards the outer edge of the bark; and in the dandelion, they are diſpoſed in the form of concentric circles.

The wood of roots is that part which appears after the bark is taken off, and is firmer and leſs porous than the bark or pith. It conſiſts of two diſtinct ſubſtances, viz. the pulpy or parenchymatous, and the ligneous. The wood is connected to the bark by large portions of the bark inſerted into it. Theſe inſertions are moſtly in the form of rays, tending to the centre of the pith, which are eaſily diſcernible by the eye in a tranſverſe ſection of moſt roots. Theſe inſertions, like the bark, conſiſt of many veſſels, moſtly of a round or oval figure.

The ligneous veſſels are generally diſpoſed in collateral rows running longitudinally through the root. Some of theſe contain air, and others ſap. The *air-veſſels* are ſo called, becauſe they contain no liquor. Theſe air-veſſels are diſtinguiſhed by being whiter than the others.

The pith is the centrical part of the root. Some roots have no pith, as the ſtramonium, nicotiana, &c.; others have little or none at the extremities of the roots, but have a conſiderable quantity of it near the top. The pith, like every other part of a plant, is derived from the ſeed; but in ſome it is more immediately derived from the bark: for the inſertions of the bark running in betwixt the rays of the wood, meet in the centre, and conſtitute the pith. It is owing to this circumſtance, that, among roots which have no pith in their lower parts, they are amply provided with it towards the top, as in columbine, lovage, &c.

The bladders of the pith are of very different ſizes, and generally of a circular figure. Their poſition is more uniform than in the bark. Their ſides are not mere films, but a compoſition of ſmall fibres or threads; which gives the pith, when viewed with a microſcope, the appearance of a piece of fine gauze or net-work.

We ſhall conclude the deſcription of roots with obſerving, that their whole ſubſtance is nothing but a congeries of tubes and fibres, adapted by nature for the abſorption of nouriſhment, and of courſe the extenſion and augmentation of their parts.

Plate cccxciv, Fig. 8. A tranſverſe ſection of the root of wormwood as it appears to the naked eye.

Fig. 9. A ſection of fig. 8. magnified. AA, the ſkin, with its veſſels. BBBB, the bark. The round holes CCC, &c. are the lymph-ducts of the bark: All the other holes are little cells and ſap-veſſels. DDD, parenchymatous inſertions from the bark, with the cells, &c. EEEE, the rays of the wood, in which the holes are the air veſſels. *N. B.* This root has no pith.

3. *Of the Trunk, Stalk, or Stem.*] In deſcribing the trunks of plants, it is neceſſary to premiſe, that whatever is ſaid with regard to them applies equally to the branches.

The trunk, like the root, conſiſts of three parts, viz. the bark, wood, and pith. Theſe parts, though ſubſtantially the ſame in the trunk as in the root, are in many caſes very different in their texture and appearance.

The ſkin of the bark is compoſed of very minute bladders, interpoſed with longitudinal woody fibres, as in the nettle, thiſtle, and moſt herbs. The outſide of the ſkin is viſibly porous in ſome plants, particularly the cane.

The principal body of the bark is compoſed of pulp or parenchyma, and innumerable veſſels much larger than thoſe of the ſkin. The texture of the pulpy part, though the ſame ſubſtance with the parenchyma in roots, yet ſeldom appears in the form of rays running towards the pith; and when theſe rays do appear, they do not extend above half way to the circumference. The veſſels of the bark are very differently ſituated, and deſtined for various purpoſes in different plants. For example, in the bark of the pine, the inmoſt are lymph ducts, and exceedingly ſmall; the outmoſt are gum or reſiniferous veſſels, deſtined for the ſecretion of turpentine; and are ſo large as to be diſtinctly viſible to the naked eye.

The wood lies between the bark and pith, and conſiſts of two parts, viz. a parenchymatous and ligneous. In all trees, the parenchymatous part of the wood, though much diverſified as to ſize and conſiſtence, is uniformly diſpoſed in diametrical rays, or inſertions running betwixt ſimilar rays of the ligneous part.

The true wood is nothing but a congeries of old dried lymph-ducts. Between the bark and the wood a new ring of theſe ducts is formed every year, which gradually loſes its ſoftneſs as the cold ſeaſon approaches, and towards the middle of winter is condenſed into a ſolid ring of wood. Theſe annual rings, which are diſtinctly viſible in moſt trees when cut through, ſerve as natural marks to diſtinguiſh their age (fig. 10. 11.) The rings of one year are ſometimes larger, ſometimes leſs, than thoſe of another, probably owing to the favourableneſs or unfavourableneſs of the ſeaſon. Plate cccxciv.

The pith, though of a different texture, is exactly of the ſame ſubſtance with the parenchyma of the bark, and the inſertions of the wood. The quantity of pith is various in different plants. Inſtead of being increaſed every year like the wood, it is annually diminiſhed, its veſſels drying up, and aſſuming the appearance and ſtructure of wood; inſomuch that in old trees there is ſcarce ſuch a thing as pith to be diſcerned.

A ring of ſap-veſſels is uſually placed at the outer edge of the pith, next the wood. In the pine, fig, and walnut, they are very large. The parenchyma of the pith is compoſed of ſmall cells or bladders, of the ſame kind with thoſe of the bark, only of a larger ſize. The general figure of theſe bladders is circular; though in ſome plants, as the thiſtle and borage, they are angular. Though the pith is originally one connected chain of bladders, yet as the plant grows old they ſhrivel and open in different directions. In the walnut after a certain age, it appears in the form of a regular tranſverſe hollow diviſion. In ſome plants it is altogether wanting; in others, as the ſonchus, nettle, &c. there is only a tranſverſe partition of it at every joint. Many other varieties might be mentioned; but theſe muſt be left to the obſervation of the reader.

Plate cccxciv.

Fig. 10. A tranſverſe ſection of a branch of aſh, as it appears to the eye.

Fig. 11. The ſame ſection magnified. AA, the bark. BBB, an arched ring of ſap-veſſels next the ſkin. CCC, the parenchyma of the bark with its cells and another arched ring of ſap-veſſels. DD, a circular line of lymph-ducts immediately below the above arched ring. EE, the wood, F, the firſt year's growth. G, the ſecond. H, the third year's growth. III, the true wood. KK, the great air-veſſels. LL, the leſſer ones. MMM, the parenchymatous inſertions of the bark repreſented by the white rays. NO, the pith, with its bladders or cells.

4. *Of the Leaves.*] The leaves of plants conſiſt of the ſame ſubſtance with that of the trunk. They are full of nerves or woody portions, running in all directions, and branching out into innumerable ſmall threads, interwoven with the parenchyma like fine lace or gauze.

The ſkin of the leaf, like that of an animal, is full of pores, which both ſerve for perſpiration and for the abſorption of dews, air, &c. Theſe pores or orifices differ both in ſhape and magnitude in different plants, which is the cauſe of that variety of texture or grain peculiar to every plant.

The pulpy or parenchymatous part conſiſts of very minute fibres, wound up into ſmall cells or bladders. Theſe cells are of various ſizes in the ſame leaf.

All leaves, of whatever figure, have a marginal fibre, by which all the reſt are bounded. The particular ſhape of this fibre determines the figure of the leaf.

The veſſels of leaves have the appearance of inoſculating; but, when examined by the microſcope; they are found only to be interwoven or laid along each other.

What are called *air-veſſels*, or thoſe which carry no ſap, are viſible even to the naked eye in ſome leaves. When a leaf is ſlowly broke, they appear like ſmall woolly fibres, connected to both ends of the broken piece.

Plate cccxcv.

Fig. 14. The appearance of the air-veſſels to the eye, in a vine-leaf drawn gently aſunder.

Fig. 15. A ſmall piece cut off that leaf.

Fig. 16. The ſame piece magnified, in which the veſſels have the appearance of a ſcrew.

Fig. 17. The appearance of theſe veſſels as they exiſt in the leaf before they are ſtretched out.

5. *Of the Flower.*] It is needleſs here to mention any thing of the texture, or of the veſſels, &c. of flowers, as they are pretty ſimilar to thoſe of the leaf. It would be foreign to our preſent purpoſe to take any notice of the characters and diſtinctions of flowers. Theſe belong to the ſcience of Botany, to which the reader is referred.

There is one curious fact, however, which muſt not be omitted, viz. That every flower is perfectly formed in its parts many months before it appears outwardly; that is, the flowers which appear this year are not properly ſpeaking the flowers of this year, but of the laſt. For example, mezereon generally flowers in January; but theſe flowers were completely formed in the month of Auguſt preceding. Of this fact any one may ſatisfy himſelf by ſeparating the coats of a tulip-root about the beginning of September; and he will find that the two innermoſt form a kind of cell, in the centre of which ſtands the young flower, which is not to make its appearance till the following April or May. Fig. 18. exhibits a view of the tulip-root when diſſected in September, with the young flower towards the bottom.

6. *Of the Fruit.*] In deſcribing the ſtructure of fruits, a few examples ſhall be taken from ſuch as are moſt generally known.

A *pear*, beſides the ſkin, which is a production of the ſkin of the bark, conſiſts of a double parenchyma or pulp, ſap, and air-veſſels, calculary and acetary.

The outer parenchyma is the ſame ſubſtance continued from the bark, only its bladders are larger and more ſucculent.

It is everywhere interſperſed with ſmall globules or grains, and the bladders reſpect theſe grains as a kind of centres, every grain being the centre of a number of bladders. The ſap and air-veſſels in this pulp are extremely ſmall.

Next the core is the inner pulp or parenchyma, which conſiſts of bladders of the ſame kind with the outer, only larger and more oblong, correſponding to thoſe of the pulp, from which it ſeems to be derived. This inner pulp is much ſourer than the other, and has none of the ſmall grains interſperſed through it; and hence it has got the name of *acetary*.

Between the acetary and outer pulp, the globules or grains begin to grow larger, and gradually unite into a hard ſtony body, eſpecially towards the corculum or ſtool of the fruit; and from this circumſtance it has been called the *calculary*.

Theſe grains are not derived from any of the organical parts of the tree; but ſeem rather to be a kind of concretions precipitated from the ſap, ſimilar to the precipitation from wine, urine and other liquors.

The core is a roundiſh cavity in the centre of the pear, lined with a hard woody membrane, in which the ſeed is incloſed. At the bottom of the core there is a ſmall duct or canal, which runs up to the top of the pear; this canal allows the air to get into the core, for the purpoſe of drying and ripening the ſeeds.

Plate cccxcvi.

Fig. 19. a tranſverſe ſection of a pear, as it appears to the naked eye. A, the ſkin, and a ring of ſap-veſſels. B, the outer parenchyma, or pulp, with its veſſels, and ligneous fibres interſperſed. C, the inner parenchyma, or acetary, with its veſſels which are larger than the outer one. D, the core and ſeeds.

Fig. 20. a piece cut off fig. 19.

Fig. 21. is fig. 20. magnified. AAA, the ſmall grains or globules, with the veſſels radiated from them.

Fig. 22. a longitudinal ſection of the pear, ſhowing a different view of the ſame parts with thoſe of fig. 19. A the channel, or duct, which runs from the top of the pear to the bottom of the core.

In a *lemon*, the parenchyma appears in three different forms. The parenchyma of the rind is of a coarſe texture, being compoſed of thick fibres, woven into large bladders. Thoſe neareſt the ſurface contain the eſſential oil of the fruit, which burſts into a flame when the ſkin is ſqueezed over a candle. From this outmoſt parenchyma nine or ten inſertions or lamellæ are produced, which run between as many portions of the pulp, and unite into one body in the centre of the fruit, which correſponds to the pith in trunks or roots. At the bottom and top of the lemon, this pith evidently joins with the rind, without the intervention of any lamellæ. This

Plant.

circumſtance ſhows, that the pith and bark are actually connected in the trunk and roots of plants, though it is difficult to demonſtrate the connection, on account of the cloſeneſs of their texture, and the minuteneſs of their fibres. Many veſſels are diſperſed through the whole of this parenchyma; but the largeſt ones ſtand on the inner edge of the rind, and the outer edge of the pith, juſt at the two extremities of each lamella.

The ſecond kind of parenchyma is placed between the rind and the pith; is divided into diſtinct bodies by the lamellæ; and each of theſe bodies forms a large bag.

Theſe bags contain a third parenchyma, which is a cluſter of ſmaller bags, diſtinct and unconnected with each other, having a ſmall ſtalk by which they are fixed to the large bag. Within each of theſe ſmall bags are many hundreds of bladders, compoſed of extremely minute fibres. Theſe bladders contain the acid juice of the lemon.

Plate cccxcv.

Fig. 12. a longitudinal ſection of a lemon. AAA, the rind with the veſſels which contain the eſſential oil BB, the ſubſtance correſponding to the pith, formed by the union of the lamellæ or inſertions. CC, its continuation and connection with the rind, independent of the inſertions.

Fig. 13. a tranſverſe ſection of the lemon. B B B, &c, the nine pulpy bags, or ſecond parenchyma, placed between the rind and the pith; and the cluſter of ſmall bags, which contain the acid juice, incloſed in the large ones. C C, the large veſſels that ſurround the pith. D D, two of the large bags laid open, ſhowing the ſeeds, and their connection with the lamellæ or membranes which form the large bags.

Of the perſpiration of P*LANTS*, *and the quantity of moiſture daily imbibed by them.*—Theſe curious particulars have been determined with great accuracy by Dr Hales. The method he took to accompliſh his purpoſe was as follows.—In the month of July, commonly the warmeſt ſeaſon of the year, he took a large ſun-flower three feet and an half high, which had been purpoſely planted in a flower-pot when young. He covered the pot with thin milled lead, leaving only a ſmall hole to preſerve a communication with the external air, and another by which he might occaſionally ſupply the plant with water. Into the former he inſerted a glaſs tube nine inches long and another ſhorter tube into the hole by which he poured in the water; and the latter was kept cloſe ſtopped with a cork, except when there was occaſion to uſe it. The holes in the bottom of the pot were alſo ſtopped up with corks, and all the crevices ſhut with cement.—Things being thus prepared, the pot and plant were weighed for 15 ſeveral days; after which the plant was cut off cloſe to the leaden plate, and the ſtump well covered with cement. By weighing, he found that there perſpired through the unglazed porous pot two ounces every 12 hours; which being allowed for in the daily weighing of the plant and pot, the greateſt perſpiration, in a warm day, was found to be one pound 14 ounces; the middle rate of perſpiration, one pound four ounces; the perſpiration of a dry warm night, without any ſenſible dew, was about three ounces; but when there was any ſenſible though ſmall dew, the perſpiration was nothing; and when there was a large dew, or ſome little rain in the night, the plant and pot was increaſed in weight two or three ounces.

Platn.

In order to know what quantity was perſpired from a ſquare inch of ſurface, our author cut off all the leaves of the plant, and laid them in five ſeveral parcels, according to their ſeveral ſizes; and then meaſured the ſurface of a leaf of each parcel, by laying over it a large lattice made with threads, in which each of the little ſquares were $\frac{1}{4}$ of an inch; by numbering of which, he had the ſurface of the leaves in ſquare inches; which, multiplied by the number of leaves in the correſponding parcels, gave the area of all the leaves. By this method he found the ſurface of the whole plant above ground to be 5616 ſquare inches, or 39 ſquare feet. He dug up another ſun-flower of nearly the ſame ſize, which had eight main roots, reaching 15 inches deep and ſidewiſe, from the ſtem. It had beſides a very thick buſh of lateral roots from the eight main roots, extending every way in a hemiſphere about nine inches from the ſtem and main roots. In order to eſtimate the length of all the roots, he took one of the main roots with its laterals, and meaſured and weighed them; and then weighed the other ſeven with their laterals; by which means he found the ſum of all their lengths to be 1448 feet. Suppoſing then the periphery of theſe roots at a medium to be 0.131 of an inch, then their ſurface will be 2276 ſquare inches, or 15.8 ſquare feet; that is, equal to 0.4 of the ſurface of the plant above ground. From calculations drawn from theſe obſervations, it appears, that a ſquare inch of the upper ſurface of this plant perſpires $\frac{1}{165}$ part of an inch in a day and a night; and that a ſquare inch of the ſurface underground imbibed $\frac{1}{67}$ of an inch in the ſame time.

The quantity perſpired by different plants, however, is by no means equal. A vine-leaf perſpires only $\frac{1}{191}$ of an inch in 12 hours; a cabbage perſpires $\frac{1}{80}$ of an inch in the ſame time; an apple-tree $\frac{1}{102}$ in 12 hours; and a lemon $\frac{1}{248}$ in 12 hours.

Of the circulation in the Sap of P*LANTS*.—Concerning this there have been great diſputes; ſome maintaining, that the vegetable ſap has a circulation analagous to the blood of animals; while others affirm, that it only aſcends in the day-time, and deſcends again in the night. In favour of the doctrine of circulation it has been urged, that upon making a tranſverſe inciſion into the trunk of a tree, the juice which runs out proceeds in greater quantity from the upper than the lower part and the ſwelling in the upper lip is alſo much greater than in the lower. It appears, however, that when two ſimilar inciſions are made, one near the top and the other near the root, the latter expends much more ſap than the former. Hence it is concluded, that the juice aſcends by one ſet of veſſels and deſcends by another. But, in order to ſhow this clearly, it would be neceſſary firſt to prove that there is in plants, as in animals, ſome kind of centre from which the circulation begins, and to which it returns; but no ſuch centre has been diſcovered by any naturaliſt; neither is there the leaſt proviſion apparently made by nature whereby the ſap might be prevented from deſcending in the very ſame veſſels through which it aſcends. In the lacteal veſſels of animals, which we may ſuppoſe to be analogous to the roots of vegetables, there are valves which effectually prevent the chyle when once abſorbed from returning into the inteſtines; but no ſuch thing is obſerved in the veſſels of vegetables: whence it muſt be very probable, that when the propelling force ceaſes, the juice deſcends by the very ſame veſſels through which it aſcended.—This matter, however, has been cleared up almoſt as well as the nature of the ſubject will admit of by the experiments of Dr Hales ‡. Theſe experiments are ſo numerous, that for a particular account of them we muſt refer to the work itſelf? however, his reaſoning againſt the circulation of the ſap will be ſufficiently intelligible without them, "We ſee (ſays he), in many of the foregoing experiments, what quantities of moiſture trees daily imbibe and perſpire: now the celerity of the ſap muſt be very great, if that quantity of moiſture muſt, moſt of it, aſcend to the top of the tree, then deſcend, and aſcend again, before it is carried off by perſpiration.

"The defect of a circulation in vegetables ſeems in ſome meaſure to be ſupplied by the much greater quantity of liquor, which the vegetable takes in, than the animal, whereby its motion is accelerated, for we find the ſun-flower, bulk for bulk, imbibes and perſpires 17 times more freſh liquor than a man, every 24 hours.

"Beſides, Nature's great aim in vegetables being only that the vegetable life be carried on and maintained, there was no occaſion to give its ſap the rapid motion which was neceſſary for the blood of animals.

"In animals, it is the heart which ſets the blood in motion and makes it continually circulate; but in vegetables we can diſcover no other cauſe of the ſap's motion but the ſtrong attraction of the capillary ſap-veſſels, aſſiſted by the briſk undulations and vibrations cauſed by the ſun's warmth, whereby the ſap is carried up to the top of the talleſt trees, and is there perſpired off through the leaves: but when the ſurface of the tree is greatly diminiſhed by the loſs of its leaves, then alſo the perſpiration and motion of the ſap is proportionably diminiſhed, as is plain from many of the foregoing experiments: ſo that the aſcending velocity of the ſap is principally accelerated by the plentiful perſpiration of the leaves, thereby making room for the fine capillary veſſels to exert their vaſtly attracting power, which perſpiration is effected by the briſk rarefying vibrations of warmth; a power that does not ſeem to be any ways well adapted to make the ſap deſcend from the tops of vegetables by different veſſels to the root.

"If the ſap circulated, it muſt needs have been ſeen deſcending from the upper part of large gaſhes cut in branches ſet in water, and with columns of water preſſing on their bottoms in long glaſs tubes. In both which caſes, it is certain that great quantities of water paſſed through the ſtem, ſo that it muſt needs have been ſeen deſcending, if the return of the ſap downwards were by truſion or pulſion, whereby the blood in animals is returned through the veins to the heart; and that pulſion, if there were any, muſt neceſſarily be exerted with prodigious force, to be able to drive the ſap through the finer capillaries. So that, if there be a return of the ſap downwards, it muſt be by attraction, and that a very powerful one, as we may ſee by many of theſe experiments. But it is hard to conceive what and where that power is which can be equivalent to that proviſion nature has made for the aſcent of the ſap in conſequence of the great perſpiration of the leaves.

"The inſtances of the jeſſamine-tree, and of the paſſion-tree, have been looked upon as ſtrong proofs of the circulation of the ſap, becauſe their branches, which were far below the inoculated bud, were gilded: but we have many viſible proofs in the vine, and other bleeding trees, of the ſap's receding back, and puſhing forwards alternately, at different times of the day and night. And there is great reaſon to think that the ſap of all other trees has ſuch an alternate, receding, and progreſſive motion, occaſioned by the alternacies of day and night, warm and cool, moiſt and dry.

"For the ſap in all vegetables does probably recede in ſome meaſure from the tops of the branches, as the ſun leaves them; becauſe its rareſying power then ceaſing, the greatly rarefied ſap, and air mixed with it, will condenſe, and take up leſs room than they did, and the dew and rain will then be ſtrongly imbibed by the leaves; whereby the body and branches of the vegetable which have been much exhauſted by the great evaporation of the day, may at night imbibe ſap and dew from the leaves; for by ſeveral experiments, plants were found to increaſe conſiderably in weight, in dewy and moiſt nights. And by other experiments on the vine, it was found that the trunk and branches of vines were always in an imbibing ſtate, cauſed by the great perſpiration of the leaves, except in the bleeding ſeaſon; but when at night that perſpiring power ceaſes, then the contrary imbibing power will prevail, and draw the ſap and dew from the leaves, as well as moiſture from the roots.

"And we have a farther proof of this by fixing mercurial gages to the ſtems of ſeveral trees which do not bleed, whereby it is found that they are always in a ſtrongly imbibing ſtate, by drawing up the mercury ſeveral inches: whence it is eaſy to conceive, how ſome of the particles of the gilded bud in the inoculated jeſſamine may be abſorbed by it, and thereby communicate their gilding miaſma to the ſap of other branches; eſpecially when, ſome months after the inoculation, the ſtock of the inoculated jeſſamine is cut off a little above the bud; whereby the ſtock, which was the counteracting part to the ſtem, being taken away, the ſtem attracts more vigorouſly from the bud.

"Another argument for the circulation of the ſap is, that ſome ſorts of the graffs will infect and canker the ſtocks they are grafted on: but by mercurial gages fixed to freſh-cut ſtems of trees, it is evident that thoſe ſtems were in a ſtrongly imbibing ſtate; and conſequently the cankered ſtocks might very likely draw ſap from the graff, as well as the graff alternately from the ſtock; juſt in the ſame manner as leaves and branches do from each other, in the viciſſitudes of day and night. And this imbibing power of the ſtock is ſo great, where only ſome of the branches of a tree are grafted, that the remaining branches of the ſtock will, by their ſtrong attraction, ſtarve thoſe graffs; for which reaſon it is uſual to cut off the greateſt part of the branches of the ſtock, leaving only a few ſmall ones to draw up the ſap.

"The inſtance of the ilex grafted upon the Engliſh oak, ſeems to afford a very conſiderable argument againſt a circulation. For, if there were a free uni-

form

‡ Vegetable Statics, vol. i. p. 142.

Plate CCCXCIV.

ANATOMY of PLANTS.

Fig. 3.

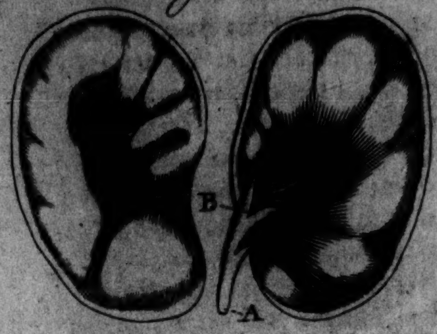


Fig. 2.

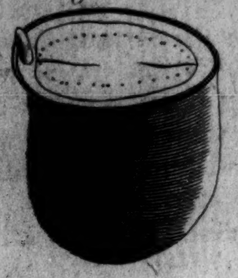


Fig. 1.

Garden Bean.

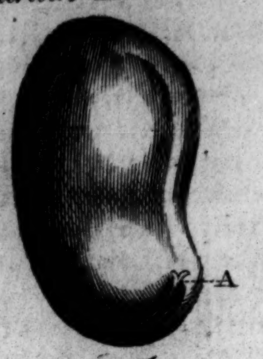


Fig. 7.

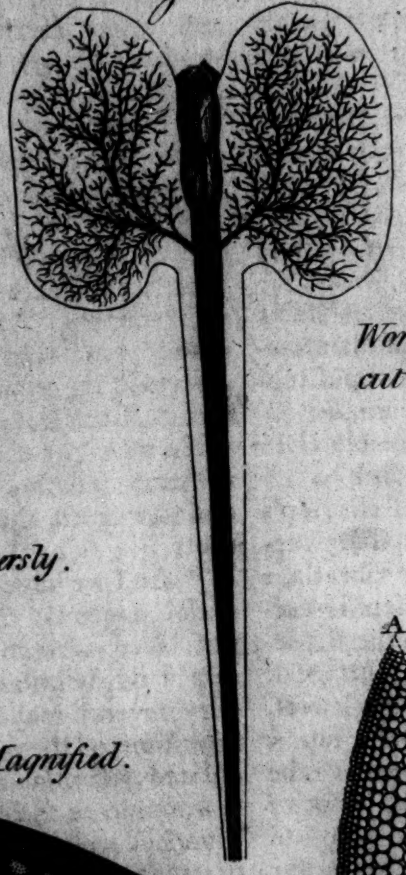


Fig. 4.

Slice of a Bean.

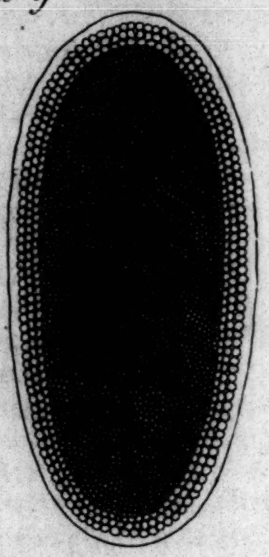


Fig. 5.

Radical.

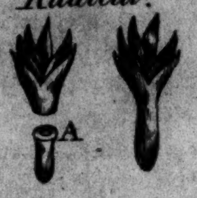


Fig. 6.

Plume.

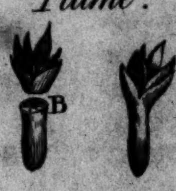


Fig. 8.

Wormwood Root cut tranſverſly.

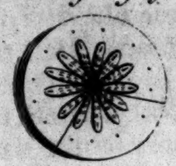


Fig. 10.

Ash Branch cut tranſversly.

Fig. 9.

Section of Fig. 8. Magnified.

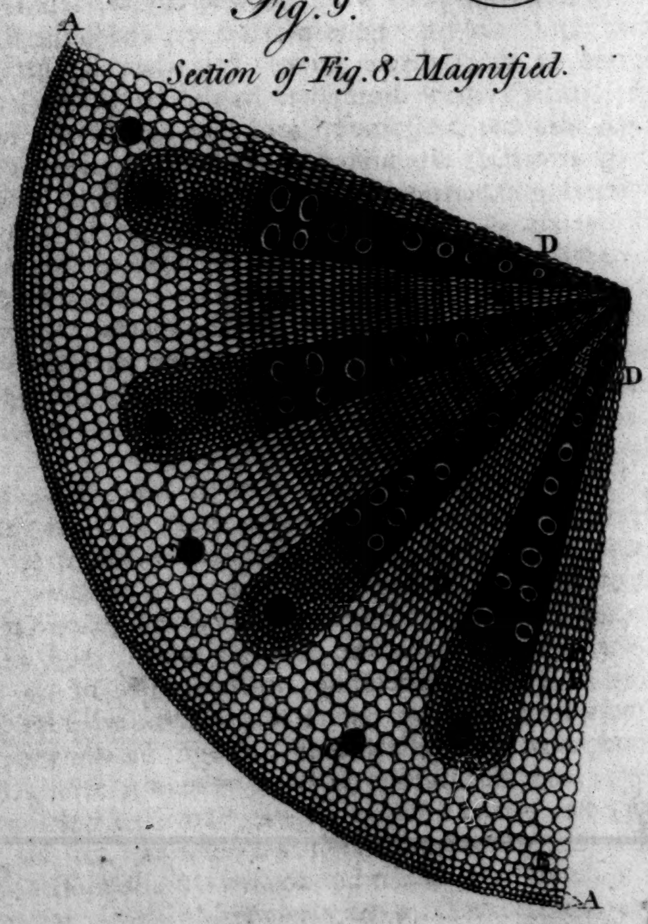
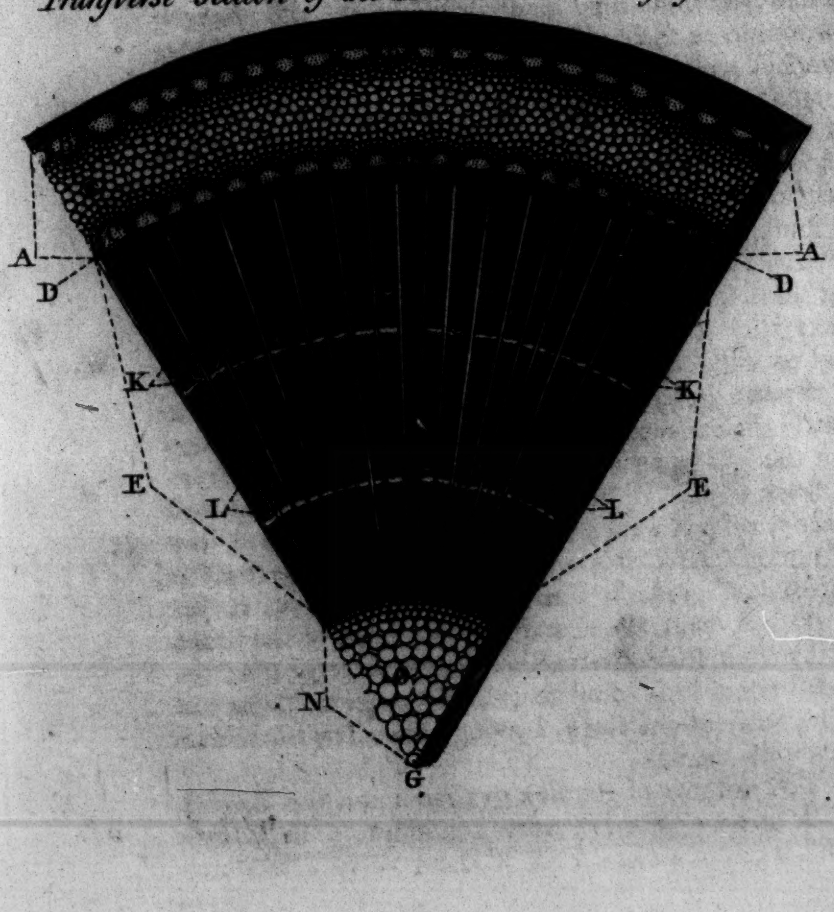


Fig. 11.

Tranſverse Section of the Ash Branch Magnified.



Vallance ſc.

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ANATOMY OF PLANTS.

Plate CCCXCV

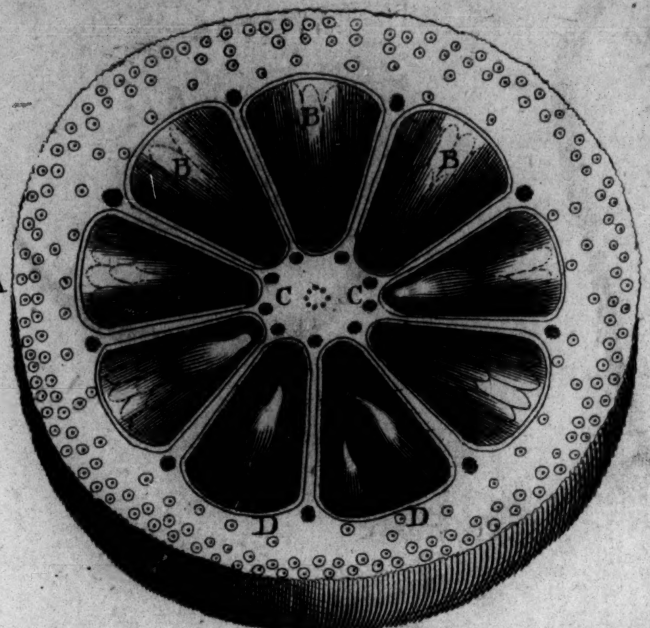
Fig. 13.
Lemon cut Transversly.

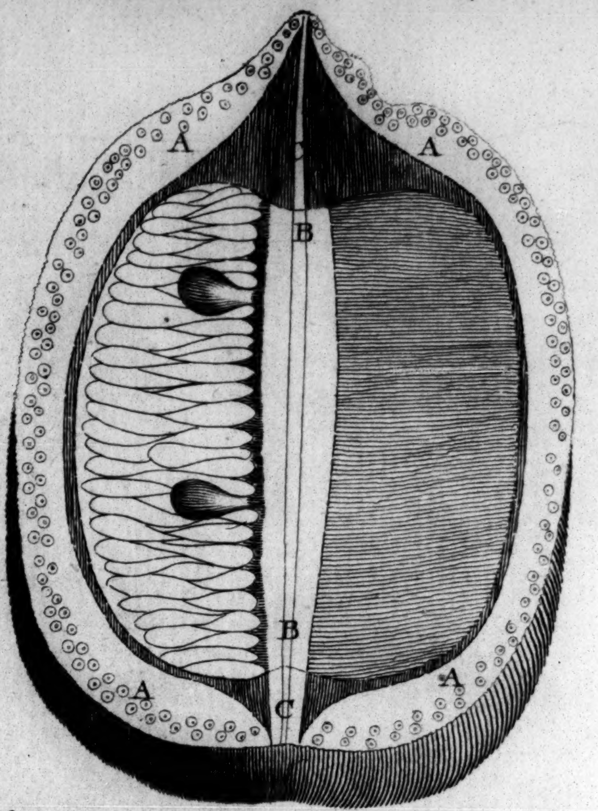
Fig. 12.
A Lemon cut down.

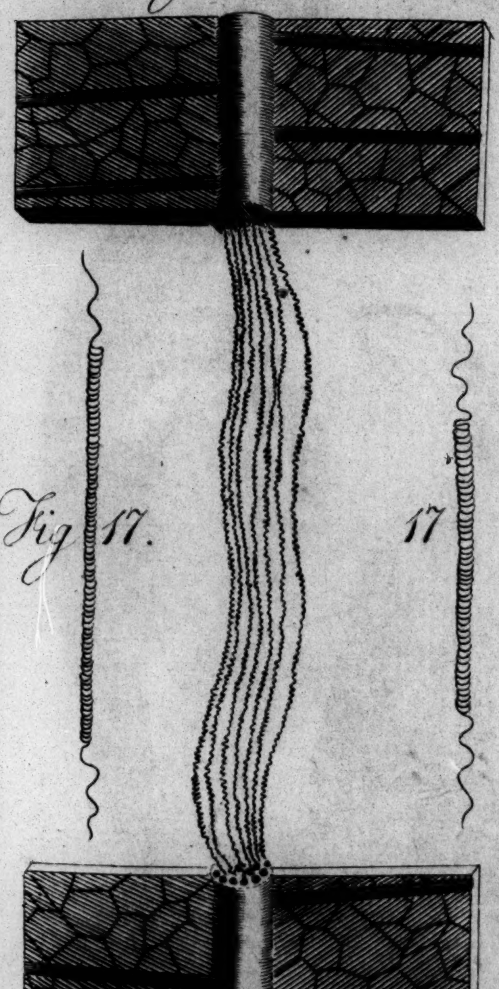
Fig. 16.

Fig. 17. 17

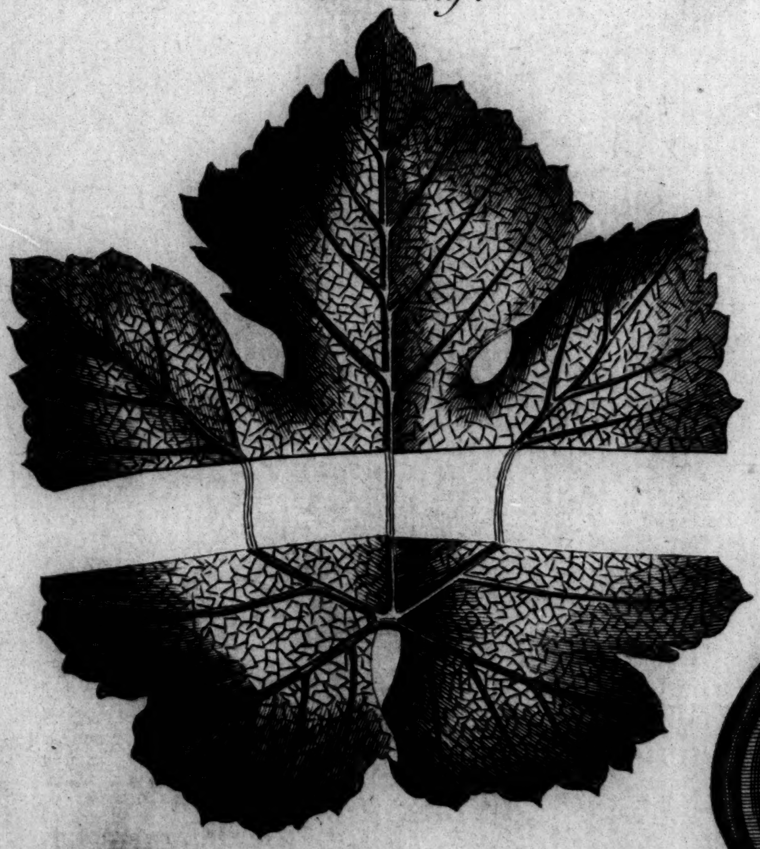
Fig. 14
Vine Leaf.

Fig. 15.

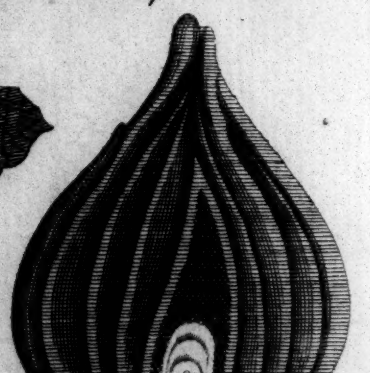
Fig. 18.
Tulip Root.

Vallance sc.

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ANATOMY *of* PLANTS.

Plate CCCXCVI

Fig. 19.

Pear cut Tranſverſeley.

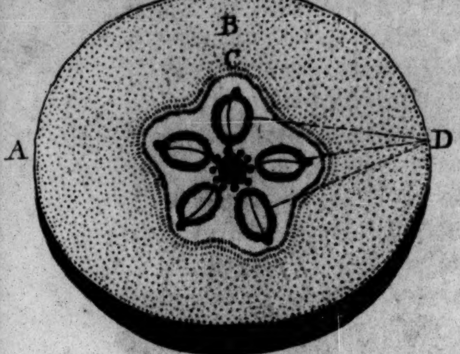


Fig. 22.

Pear cut Longitudinally.

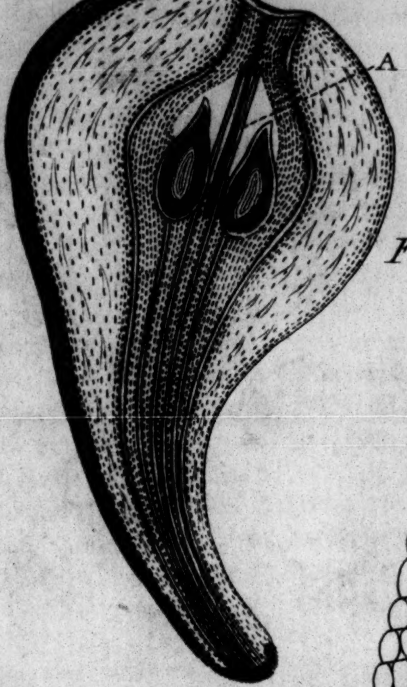


Fig. 21.

Fig 20 Magnified.

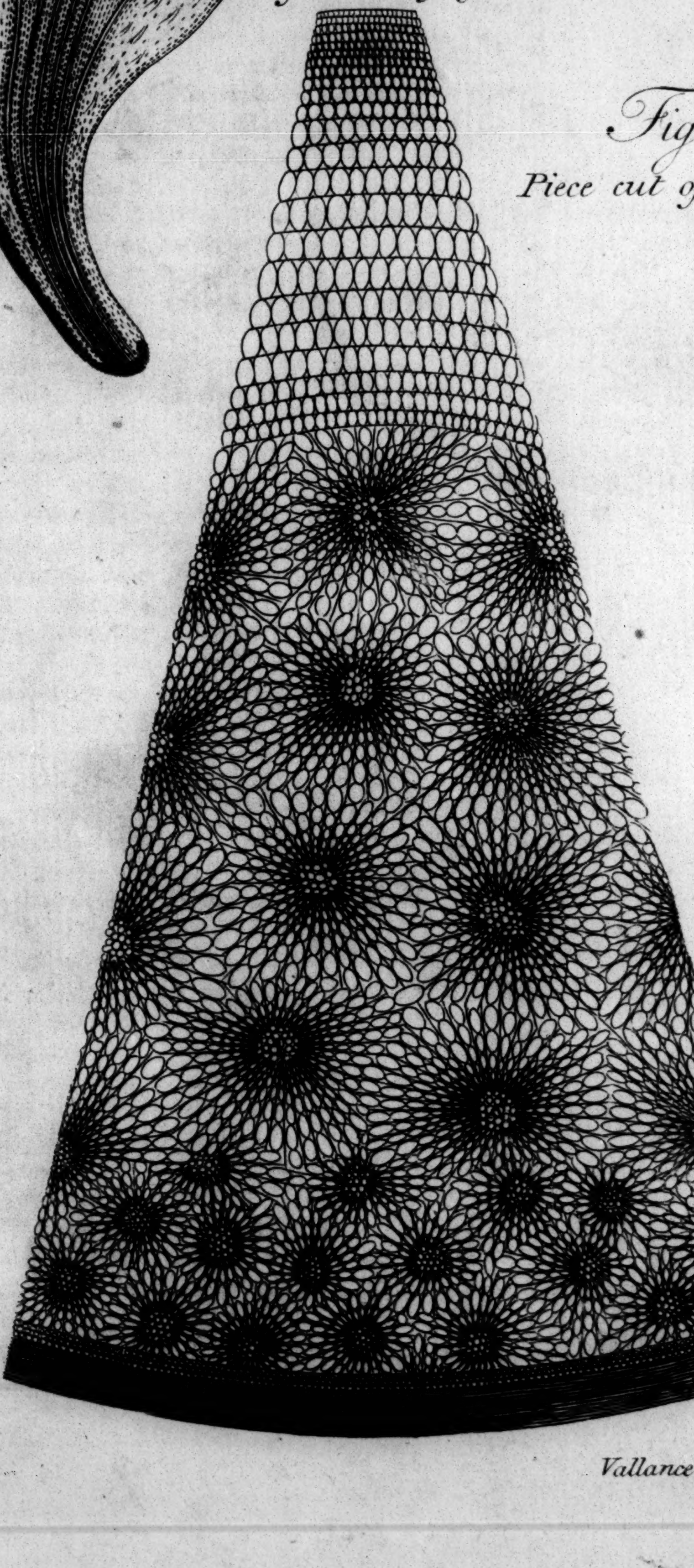
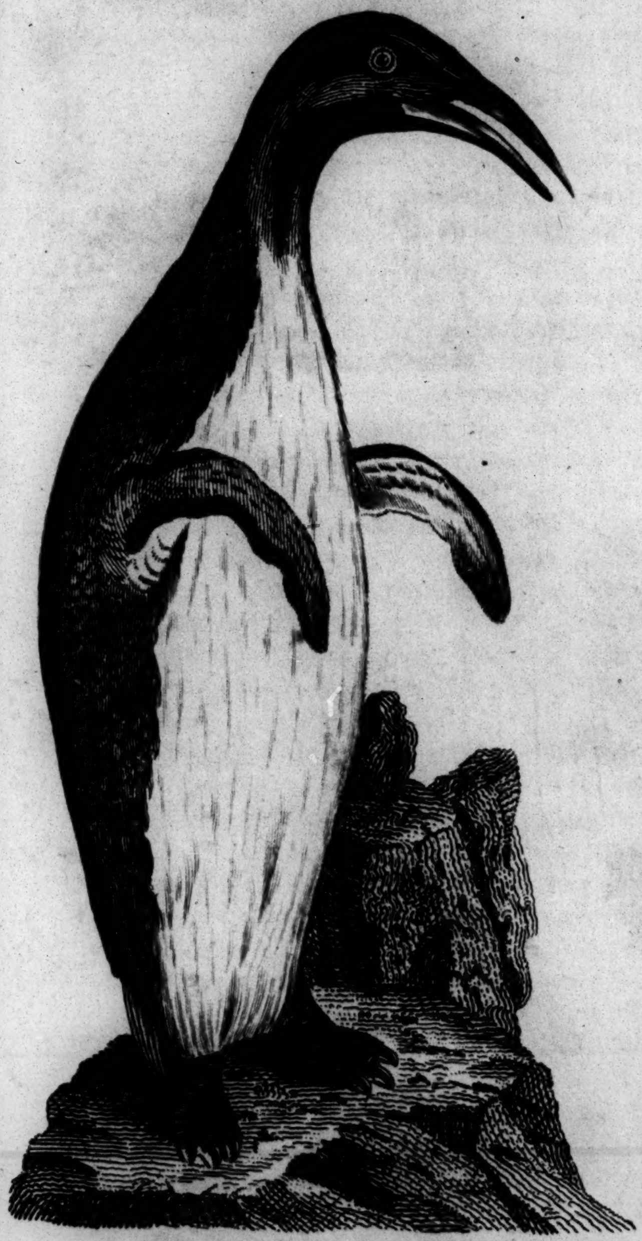


Fig. 20.

Piece cut off Fig. 19.

Patagonian Pinguin.



Vallance ſc

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form circulation of the ſap through the oak and ilex, why ſhould the leaves of the oak fall in winter, and not thoſe of the ilex?

"Another argument againſt an uniform circulation of the ſap in trees, as in animals, may be drawn from an experiment, where it was found by the three mercurial gages fixed to the ſame vine, that while ſome of its branches changed their ſtate of protruding ſap into a ſtate of imbibing, others continued protruding ſap; one nine, and the other thirteen days longer."

To this reaſoning of Dr Hales we ſhall ſubjoin an experiment made by Mr Muſtel of the Academy of Sciences at Rouen, which ſeems deciſive againſt the doctrine of circulation. His account of it is as follows.—"On the 12th of January I placed ſeveral ſhrubs in pots againſt the windows of my hot-houſe, ſome within the houſe and others without it. Through holes made for this purpoſe in the panes of glaſs, I paſſed a branch of each of the ſhrubs, ſo that thoſe on the inſide had a branch without, and thoſe on the outſide one within; after this, I took care that the holes ſhould be exactly cloſed and luted. This inverſe experiment, I thought, if followed cloſely, could not fail affording ſufficient points of compariſon to trace out the differences, by the obſervation of the effects.

"The 20th of January, a week after this diſpoſition, all the branches that were in the hot-houſe began to diſcloſe their buds. In the beginning of February there appeared leaves; and towards the end of it, ſhoots of a conſiderable length, which preſented the young flowers. A dwarf apple-tree, and ſeveral roſe-trees, being ſubmitted to the ſame experiment, ſhowed the ſame appearance then as they commonly put on in May; in ſhort, all the branches which were within the hot-houſe, and conſequently kept in the warm air, were green at the end of February, and had their ſhoots in great forwardneſs. Very different were thoſe parts of the ſame tree which were without and expoſed to the cold. None of theſe gave the leaſt ſign of vegetation; and the froſt, which was intenſe at that time, broke a roſe-pot placed on the outſide, and killed ſome of the branches of that very tree which, on the inſide, was every day putting forth more and more ſhoots, leaves, and buds, ſo that it was in full vegetation on one ſide, whilſt frozen on the other.

"The continuance of the froſt occaſioned no change in any of the internal branches. They all continued in a very briſk and verdant ſtate, as if they did not belong to the tree which, on the outſide appeared in the ſtate of the greateſt ſuffering. On the 15th of March, notwithſtanding the ſeverity of the ſeaſon, all was in full bloom. The apple-tree had its root, its ſtem, and part of its branches, in the hot-houſe. Theſe branches were covered with leaves and flowers; but the branches of the ſame tree, which were carried on the outſide, and expoſed to the cold air, did not in the leaſt partake of the activity of the reſt, but were abſolutely in the ſame ſtate which all trees are in during winter. A roſe-tree, in the ſame poſition, ſhowed long ſhoots with leaves and buds; it had even ſhot a vigorous branch upon its ſtalk; whilſt a branch which paſſed through to the outſide had not begun to produce any thing but was in the ſame ſtate with other roſe-trees left in the ground. This branch is four lines in diameter, and 18 inches high.

"The roſe-tree on the outſide was in the ſame ſtate; but one of its branches drawn through to the inſide of the hot-houſe was covered with leaves and roſe-buds. It was not without aſtoniſhment that I ſaw this branch ſhoot as briſkly as the roſe-tree which was in the hot-houſe, whoſe roots and ſtalk, expoſed as they were to the warm air, ought, it ſhould ſeem, to have made it get forwarder than a branch belonging to a tree, whoſe roots, trunk, and all its other branches, were at the very time froſt-nipped. Notwithſtanding this, the branch did not ſeem affected by the ſtate of its trunk; but the action of the heat upon it produced the ſame effect as if the whole tree had been in the hot-houſe."

Memoires de l'Acad. Royal des Sciences, an. 1708.

Of the Perpendicularity of Plants.—This is a curious phenomenon in natural hiſtory, which was firſt obſerved by M. Dodart, and publiſhed in an eſſay on the affectation of perpendicularity obſerved in the ſtems or ſtalks of all plants, in the roots of many, and even in their branches as much as poſſible. Though almoſt all plants riſe a little crooked, yet the ſtems ſhoot up perpendicularly, and the roots ſink down perpendicularly: even thoſe, which by the declivity of the ſoil come out inclined, or thoſe which are diverted out of the perpendicular by any violent means, again redreſs and ſtrengthen themſelves and recover their perpendicularity, by making a ſecond and contrary bend or elbow without rectifying the firſt. We commonly look upon this affectation without any ſurpriſe; but the naturaliſt who knows what a plant is, and how it is formed, finds it a ſubject of aſtoniſhment.

Each ſeed we know contains in it a little plant, already formed, and needing nothing but to be unfolded, the litttle plant has its root; and the pulp which is uſually ſeparated into two lobes, is the foundation of the firſt food it draws by its root when it begins to germinate. If a ſeed in the earth therefore be diſpoſed ſo as that the root of the little plant be turned downwards, and the ſtem upwards, and even perpendicularly upwards, it is eaſy to conceive that the little plant coming to unfold itſelf, its ſtalk and root need only follow the direction they have to grow perpendicularly. But we know that the ſeeds of plants, whether ſown of themſelves or by man, fall in the ground at random; and among the great variety of ſituations with regard to the ſtalk of their plant, the perpendicular one upwards is but one. In all the reſt, therefore, it is neceſſary that the ſtalk rectify itſelf, ſo as to get out of the ground: but what force effects this change, which is unqueſtionably a violent action? Does the ſtalk find a leſs load of earth above it and therefore grow naturally that way where it finds the leaſt obſtacle? Were this ſo, the little root, when it happens to be uppermoſt, muſt alſo follow that direction, and mount up.

To account for two ſuch different actions, M. Dodart ſuppoſes that the fibres of the ſtalks are of ſuch a nature as to be contracted and ſhortened by the heat of the ſun, and lengthened out by the moiſture of the earth; and on the contrary, that the fibres of the roots are contracted by the moiſture of the earth, and lengthened by the heat of the ſun. When the plantule therefore is inverted, and the root at the top, the fibres which compoſe one of the branches of the root are not alike expoſed to the moiſture of the earth, the lower part being more expoſed than the upper. The lower muſt of courſe contract the moſt; and this contraction is again promoted by the lengthening of the upper, whereon the ſun acts with the greateſt force. This branch of the root muſt therefore recoil towards the earth, and, inſinuating through the pores thereof, muſt get underneath the bulb, &c. By inverting this reaſoning we diſcover how the ſtalk comes to get uppermoſt.

We ſuppoſe then that the earth attracts the root to itſelf, and that the ſun contributes to its deſcent; and, on the other hand, that the ſun attracts the ſtem, and the earth contributes to ſend it towards the ſame. With reſpect to the ſtraightening of the ſtalks in the open air, our author imagines that it ariſes from the impreſſion of external cauſes, particularly the ſun and rain. For the upper part of a ſtalk that is bent is more expoſed to the rain, dew, and even the ſun, &c. than the under; and theſe cauſes, in a certain ſtructure of the fibres, both equally tend to ſtraighten the part moſt expoſed by the ſhortening they ſucceſſively occaſion in it; for moiſture ſhortens by ſwelling and heat by diſſipating. What that ſtructure is which gives the fibres ſuch different qualities, or whereon it depends, is a myſtery as yet beyond our depth.

M. de la Hire accounts for the perpendicularity of the ſtems or ſtalks of plants in this manner: he ſuppoſes that the root of plants draws a coarſer and heavier juice, and the ſtem and branches a finer and more volatile one. Moſt naturaliſts indeed conceive the root to be the ſtomach of the plant, where the juices of the earth are ſubtilized ſo as to become able to riſe through the ſtem to the extremity of the branches. This difference of juices ſuppoſes larger pores in the roots than the ſtalk, &c. and, in a word, a different contexture. This difference muſt be found even in the little inviſible plant incloſed in the ſeed: in it, therefore, we may conceive a point of ſeparation; ſuch as, that all on one ſide, for example the root, ſhall be unfolded by the groſſer juices, and all on the other ſide by the more ſubtile ones. Suppoſe the plantule, when its parts begin to unfold, to be entirely inverted, the root at the top, and the ſtalk below; the juices entering the root will be coarſeſt, and when they have opened and enlarged the pores ſo as to admit juices of a determinate weight, thoſe juices preſſing the root more and more will drive it downwards; and this will increaſe as the root is more extended or enlarged: for the point of ſeparation being conceived as the fixed point of a lever, they will act by the longer arm. The volatile juices at the ſame time having penetrated the ſtalk, will give it a direction from below upwards; and, by reaſon of the lever, will give it more and more every day. The little plant is thus turned on its fixed point of ſeparation till it become perfectly erect.

When the plant is thus erected, the ſtalk ſhould ſtill riſe perpendicularly, in order to give it the more firm abiding, and enable it to withſtand the effort of wind and weather. M. Parent thus accounts for this effect: If the nutritious juice which arrived at the extremity of a riſing ſtalk evaporate, the weight of the air which encompaſſes it on all ſides will make it aſcend vertically: but if, inſtead of evaporating, it congeal and remain fixed to that extremity whence it was ready to go off, the weight of the air will give it the ſame direction; ſo that the ſtalk will have acquired a ſmall new part vertically laid over it, juſt as the flame in a candle held in any way obliquely to the horizon ſtill continues vertical by the preſſure of the atmoſphere. The new drops of juice that ſucceed will follow the ſame direction; and as altogether from the ſtalk, that muſt of courſe be vertical, unleſs ſome particular circumſtance intervene.

The branches, which are at firſt ſuppoſed to proceed laterally out of the ſtalk in the firſt embryo of the plant, though they ſhould even come out in a horizontal direction, muſt alſo raiſe themſelves upwards by the conſtant direction of the nutritious juice, which at firſt ſcarce meets any reſiſtance in a tender ſupple branch; and afterwards, even though the branch grow more firm, it will act with the more advantage; ſince the branch, being become longer, furniſhes it with a longer arm or lever. The ſlender action of even a little drop becomes very conſiderable by its continuity, and by the aſſiſtance of ſuch circumſtances. Hence may we account for that regular ſituation and direction of the branches, ſince they all make nearly the ſame conſtant angle of 45° with the ſtem, and with one another.

M. Aſtruc accounts for the perpendicularity of the ſtems, and their redreſſing themſelves, thus: 1. He thinks the nutritious juice ariſes from the circumference of the plant, and terminates in the pith: And, 2. That fluids, contained in tubes either parallel or oblique to the horizon, gravitate on the lower part of the tubes, and not at all on the upper. Hence it follows, that, in a plant placed either obliquely or parallel to the horizon, the nutritious juice will act more on the lower part of the canals than on the upper; and by this means they will inſinuate more into the canals communicating therewith, and be collected more copiouſly therein: thus the parts on the lower ſide will receive more accretion and be more nouriſhed than thoſe on the upper, the extremity of the plant will therefore be obliged to bend upwards.

This principle brings the ſeed into its due ſituation at firſt. In a bean planted upſide down, the plume and radicle may be ſeen with the naked eye ſhooting at firſt directly for about an inch; after which they begin to bend the one downward, and the other upward. The ſame is the caſe in a heap of barley to be made into to malt, or in a quantity of acorns laid to ſprout in a moiſt place, &c. Each grain of barley and each acorn has a different ſituation; and yet every ſprout tends directly upward, and every root downward, and the curvity or bend they make is greater or leſs as their ſituation approaches more or leſs to the direction wherein no curvature at all would be neceſſary. But two ſuch oppoſite motions cannot poſſibly ariſe without ſuppoſing ſome difference between the two parts: the only one we know of is that the plume is fed by a juice imported to it by tubes parallel to its ſides whereas the radicle imbibes its nouriſhment at every pore in its ſurface. When the plume therefore is either parallel or inclined to the horizon, the nutritious juice, feeding the lower parts more than the upper, will determine its extremes to turn upward, for the reaſons before given. On the contrary when the radicle is in the like ſituation, the nutritious juice penetrating through the upper part more copiouſly than through the under, there will be a greater accretion of the former than of the latter; and the radicle will therefore be bent downwards, and this mutual curvity of the plume and radicle muſt continue till ſuch time as their ſides are nouriſhed alike, which cannot be till they are perpendicular.

Of the Food of PLANTS.—This hath been ſo fully diſcuſſed under the article AGRICULTURE †, that little remains to be ſaid upon the ſubject in this place. The method of making deghlogiſticated or vital air *de novo*, is now ſo much improved, that numberleſs experiments may be made with it both on animals and vegetables. It appears, indeed, that theſe two parts of the creation are a kind of counterbalance to one another; and the noxious parts or excrements of the one prove ſalutary food to the other. Thus, from the animal body continually paſs off certain effluvia, which vitiate or *phlogiſticate* the air. Nothing can be more prejudicial to animal life than an accumulation of theſe effluvia: on the other hand, nothing is more favourable to vegetables than thoſe excrementitious effluvia of animals; and accordingly they greedily abſorb them from the earth, or from the air. With reſpect to the excrementitious parts of living vegetables, the caſe is reverſed. The pureſt air is the common effluvium which paſſes off from vegetables; and this, however favourable to animal life, is by no means ſo to vegetable; whence we have an additional proof of the doctrine concerning the food of plants delivered under the article AGRICULTURE.

With regard to the effects of other kinds of air on vegetation, a difference of ſome conſequence took place between Dr Prieſtley and Dr Percival. The former, in the firſt volume of his Experiments and Obſervations on Air, had aſſerted that fixed air is fatal to vegetable as well as to animal life. This opinion, however, was oppoſed by Dr Percival, and the contrary one adopted by Dr Hunter of York in the Georgical Eſſays, vol. v. The experiments related by theſe two gentlemen would indeed have been deciſive, had they been made with ſufficient accuracy. That this was the caſe, however, Dr Prieſtley denies; and in the 3d volume of his Treatiſe on Air has fully detected the miſtakes in Dr Percival's experiments; which proceeded in fact from his having uſed, not fixed air, but common air mixed with a ſmall quantity of fixed air. His experiments, when repeated with the pureſt fixed air, and in the moſt careful manner, were always attended with the ſame effect, namely, the killing of the plant.

It had alſo been aſſerted by Drs Percival and Hunter, that water impregnated with fixed air was more favourable to vegetation than ſimple water. This opinion was likewiſe examined by Dr Prieſtley: however, his experiments were indeciſive; but ſeem rather unfavourable to the uſe of fixed air than otherwiſe.

Another very remarkable fact with regard to the food of plants has been diſcovered by Dr Prieſtley; namely, that ſome of them, ſuch as the willow, comfrey, and duck-weed, are nouriſhed by inflammable air. The firſt, he ſays, flouriſhes in this ſpecies of air ſo remarkably, that, "it may be ſaid to feed upon it with great avidity. This proceſs terminates in the change of what remains of the inflammable air into phlogiſticated air, and ſometimes into a ſpecies of air as good as common air, or even better, ſo that it muſt be the *inflammable principle* in the air that the plant takes, converting it, no doubt, into its proper nouriſhment."

Prieſtley on Air, vol. v. p. 2.

What the followers of Stahl call phlogiſticated air and inflammable air, are ſo cloſely allied to each other, that it is no wonder they ſhould ſerve promiſcuouſly for the food of plants. The reaſon why both are not agreeable to all kinds of plants, moſt probably is the different quantity of phlogiſtic matter contained in them, and the different action of the latent fire they contain: for all plants do not require an equal quantity of nouriſhment; and ſuch as require but little, will be deſtroyed by having too much. The action of heat alſo is eſſentially neceſſary to vegetation; and it is probable that very much of this principle is abſorbed from the air by vegetables. But if the air by which plants are partly nouriſhed contains too much of that principle, it is very probable that they may be deſtroyed from this cauſe as well as the other; and thus inflammable air, which contains a vaſt quantity of that active principle, may deſtroy ſuch plants as grow in a dry ſoil, though it preſerves thoſe which grow in a wet one. See VEGETATION.

Diſſemination of PLANTS.—So great are the prolific powers of the vegetable kingdom, that a ſingle plant almoſt of any kind, if left to itſelf, would, in a ſhort time, over-run the whole world. Indeed, ſuppoſing the plant to have been only a ſingle annual, with two ſeeds, it would, in 20 years, produce more than a million of its own ſpecies; what numbers then muſt have been produced by a plant whoſe ſeeds are ſo numerous as many of thoſe with which we are acquainted? See *NATURAL Hiſtory*, ſect. iii. p. 654, &c. In that part of our work we have given particular examples of the very prolific nature of plants, which we need not repeat here; and we have made ſome obſervations on the means by which they are carried to diſtant places. This is a very curious matter of fact, and as ſuch we ſhall now give a fuller account of it.

If nature had appointed no means for the ſcattering of theſe numerous ſeeds, but allowed them to fall down in the place where they grew, the young vegetables muſt of neceſſity have choaked one another as they grew up, and not a ſingle plant could have arrived at perfection. But ſo many ways are there appointed for the diſſemination of plants, that we ſee they not only do not hinder each others growth, but a ſingle plant will in a ſhort time ſpread through different countries. The moſt evident means for this purpoſe are,

1. The force of the air.—That the efficacy of this may be the greater, nature has raiſed the ſeeds of vegetables upon ſtalks, ſo that the wind has thus an opportunity of acting upon them with the greater advantage. The ſeed-capſules alſo open at the apex, leſt the ripe ſeeds ſhould drop out without being widely diſperſed by the wind. Others are furniſhed with wings, and a pappous down, by which, after they come to maturity, they are carried up into the air, and have been known to fly the diſtance of 50 miles: 138 genera are found to have winged ſeeds.

2. In ſome plants the ſeed-veſſels open with violence when the ſeeds are ripe, and thus throw them to a conſiderable diſtance; and we have an enumeration of 50 genera whoſe ſeeds are thus diſperſed.

3. Other ſeeds are furniſhed with hooks, by which, when ripe, they adhere to the coats of animals, and are carried by them to their lodging places. Linnæus reckons 50 genera armed in this manner.

4. Many ſeeds are diſperſed by means of birds and other animals; who pick up the berries, and afterwards eject the ſeeds uninjured. Thus the fox diſſeminates the privet, and man many ſpecies of fruit. The plants found growing upon walls and houſes, on the tops of

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† Part i. ſect. 1.

high rocks, &c. are moſtly brought there by birds; and it is univerſally known, that by manuring a field with new dung, innumerable weeds will ſpring up which did not exiſt there before: 193 ſpecies are reckoned up which may be diſſeminated in this manner.

5. The growth of other ſeeds is promoted by animals in a different way. While ſome are eaten, others are ſcattered and trodden into the ground by them. The ſquirrel gnaws the cones of the pine, and many of the ſeeds fall out. When the loxica eats off their bark, almoſt his only food, many of their ſeeds are committed to the earth, or mixed in the moraſs with moſs, where he had retired. The glandularia, when ſhe hides up her nuts, often forgets them, and they ſtrike root. The ſame is obſervable of the walnut; mice collect and bury great quantities of them, and being afterwards killed by different animals, the nuts germinate.

6. We are aſtoniſhed to find moſſes, fungi, byſſus, and mucor, growing everywhere; but it is for want of reflecting that their ſeeds are ſo minute that they are almoſt inviſible to the naked eye. They float in the air like atoms, and are dropped everywhere, but grow only in thoſe places where there was no vegetation before; and hence we find the ſame moſſes in North America and in Europe.

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7. Seeds are alſo diſperſed by the ocean and by rivers. "In Lapland (ſays Linnæus), we ſee the moſt evident proofs how far rivers contribute to depoſite the ſeeds of plants. I have ſeen Alpine plants growing upon their ſhores frequently 36 miles diſtant from the Alps; for their ſeeds falling into the rivers, and being carried along and left by the ſtream, take root there.—We may gather likewiſe from many circumſtances how much the ſea furthers this buſineſs.—In Roſlagia, the iſland of Græſœa, Oeland, Gothland, and the ſhores of Scania, there are many foreign and German plants not yet naturalized in Sweden. The centaury is a German plant, whoſe ſeeds being carried by the wind into the ſea, the waves landed this foreigner upon the coaſts of Sweden. I was aſtoniſhed to ſee the veronica maritima, a German plant, growing at Tornea, which hitherto had been found only in Græſœa: the ſea was the vehicle by which this plant was tranſported thither from Germany; or poſſibly it was brought from Germany to Græſœa, and from thence to Tornea. Many have imagined, but erroneouſly, that ſeed corrupts in water, and loſes its principle of vegetation. Water at the bottom of the ſea is ſeldom warm enough to deſtroy ſeeds; we have ſeen water cover the ſurface of a field for a whole winter, while the ſeed which it contained remained unhurt, unleſs at the beginning of ſpring the waters were let down ſo low by drains, that the warmth of the ſunbeams reached to the bottom. Then the ſeeds germinate, but preſently become putreſcent; ſo that for the reſt of the year the earth remains naked and barren. Rain and ſhowers carry ſeeds into the cracks of the earth, ſtreams, and rivers; which laſt, conveying them to a diſtance from their native places, plant them in a foreign ſoil."

8. Laſtly, ſome ſeeds aſſiſt their projection to a diſtance in a very ſurpriſing manner. The crupina, a ſpecies of centaury, has its ſeeds covered over with erect briſtles, by whoſe aſſiſtance it creeps and moves about in ſuch a manner, that it is by no means to be kept in the hand. If you confine one of them between the ſtocking and the foot, it creeps out either at the ſleeve or neck-band, travelling over the whole body. If the bearded oat, after harveſt, be left with other grain in the barn, it extricates itſelf from the glume; nor does it ſtop in its progreſs till it gets to the walls of the building. Hence, ſays Linnæus, the Dalecarlian, after he has cut and carried it into the barn, in a few days finds all the glumes empty, and the oats ſeparate from them; for every oat has a ſpiral ariſta or beard annexed to it, which is contracted in wet, and extended in dry weather. When the ſpiral is contracted, it drags the oat along with it: the ariſta being bearded with minute hairs pointing downward, the grain neceſſarily follows it; but when it expands again, the oat does not go back to its former place, the roughneſs of the beard the contrary way preventing its return. If you take the ſeeds of equiſetum, or fern, theſe being laid upon paper, and viewed in a microſcope, will be ſeen to leap over any obſtacle as if they had feet; by which they are ſeparated and diſperſed one from another; ſo that a perſon ignorant of this property would pronounce theſe ſeeds to be ſo many mites or ſmall inſects.

We cannot finiſh this article without remarking, that many ingenious men (A) believe that plants have a power of perception. Of this opinion we ſhall now give an account from the ſecond volume of the Mancheſter Tranſactions, where we find ſome *ſpeculations on the perceptive power of vegetables by Dr Percival*, who attempts to ſhow, by the ſeveral analogies of organization, life, inſtinct, ſpontaneity, and ſelf-motion, that plants, like animals, are endued with the powers both of perception and enjoyment. The attempt is ingenious, and is ingeniouſly ſupported, but in our opinion fails to convince. That there is an analogy between animals and vegetables is certain; but we cannot from thence conclude that they either perceive or enjoy. Botaniſts have, it is true, derived from *anatomy* and *phyſiology*, almoſt all the terms employed in the deſcription of plants. But we cannot from thence conclude, that their organization, tho' it bears an analogy to that of animals, is the ſign of *a living principle*, if to this *principle* we annex the idea of *perception*; yet ſo fully is our author convinced of the truth of it, that he does not think it extravagant to ſuppoſe, that, in ſome future period, perceptivity may be diſcovered to extend even beyond the limits now aſſigned to vegetable life. Corallines, madrepores, millepores, and ſpunges, were formerly conſidered as foſſil bodies:

(A) The ingenious Dr Bell held this opinion, as appears from the cloſe of his *Theſis de Phyſiologia Plantarum*, which was publiſhed at Edinburgh, June 1777, and a tranſlation of which by Dr Currie we find in the ſecond volume of the Mancheſter Tranſactions, where our readers will alſo find memoirs of its author. Dr Currie informs us, that Dr Hope, the late excellent profeſſor of botany in Edinburgh, in his courſe of lectures, uſed to ſpeak of Dr Bell with the higheſt eſteem; but did not approve of the idea which he entertained reſpecting the feeling or perception of plants.

dies; but the experiments of Count Marſigli evinced, that they are endued with life, and led him to claſs them with the maritime plants, And the obſervations of Ellis, Juſſieu, and Peyſonel, have ſince raiſed them to the rank of animals. The detection of error, in long eſtabliſhed opinions concerning one branch of natural knowledge, juſtifies the ſuſpicion of its exiſtence in others, which are nearly allied to it. And it will appear from the proſecution of our inquiry into the inſtincts, ſpontaneity, and ſelf-moving power of vegetables, that the ſuſpicion is not without foundation.

He then goes on to draw a compariſon between the inſtincts of animals and thoſe of vegetables: the calf, as ſoon as it comes into the world, applies to the teats of the cow; and the duckling, though hatched under a hen, runs to the water.

“ Inſtincts analogous to theſe (ſays our author), operate with equal energy on the vegetable tribe. A ſeed contains a germ, or plant in miniature, and a radicle, or little root, intended by nature to ſupply it with nouriſhment. If the ſeed be ſown in an inverted poſition, ſtill each part purſues its proper direction. The plumula turns upward, and the radicle ſtrikes downward into the ground. A hop-plant, turning round a pole, follows the courſe of the ſun, from ſouth to weſt, and ſoon dies, when forced into an oppoſite line of motion: but remove the obſtacle, and the plant will quickly return to its ordinary poſition. The branches of a honey-ſuckle ſhoot out longitudinally, till they become unable to bear their own weight; and then ſtrengthen themſelves, by changing their form into a ſpiral: when they meet with other living branches, of the ſame kind, they coaleſce, for mutual ſupport, and one ſpiral turns to the right and the other to the left; thus ſeeking, by an inſtinctive impulſe, ſome body on which to climb, and increaſing the probability of finding one by the diverſity of their courſe: for if the auxiliary branch be dead, the other uniformly winds itſelf round from the right to the left.

“ Theſe examples of the inſtinctive economy of vegetables have been purpoſely taken from ſubjects familiar to our daily obſervation. But the plants of warmer climates, were we ſufficiently acquainted with them, would probably furniſh better illuſtrations of this acknowledged power of animality: and I ſhall briefly recite the hiſtory of a very curious exotic, which has been delivered to us from good authority; and confirmed by the obſervations of ſeveral European botaniſts.”

The Doctor then goes on to give a deſcription of the *dionæa muſcipula* (B), for which ſee vol. vi. p. 32. and concludes, that if he has furniſhed any preſumptive proof of the inſtinctive power of vegetables, it will neceſſarily follow that they are endued with ſome degree of ſpontaneity. More fully to evince this, however, the Doctor points out a few of thoſe phenomena in the vegetable kingdom which ſeem to indicate ſpontaneity.—“ Several years ago (ſays he), whilſt engaged in a courſe of experiments to aſcertain the influence of fixed air on vegetation, the following fact repeatedly occurred to me. A ſprig of mint, ſuſpended by the root, with the head downwards, in the middle glaſs veſſel of Dr Nooth's machine, continued to thrive vigorouſly, without any other pabulum than what was ſupplied by the ſtream of mephitic gas to which it was expoſed. In 24 hours the ſtem formed into a curve, the head became erect, and gradually aſcended towards the mouth of the veſſel; thus producing, by ſucceſſive efforts, a new and unuſual configuration of its parts. Such exertions in the ſprig of mint, to rectify its inverted poſition, and to remove from a foreign to its natural element, ſeems to evince evolition to avoid what was evil, and to recover what had been experienced to be good. If a plant, in a garden-pot, be placed in a room which has no light except from a hole in the wall, it will ſhoot towards the hole, paſs through it into the open air and then vegetate upwards in its proper direction. Lord Kames relates, that, ‘ amongſt the ruins of New Abbey, formerly a monaſtery in Galloway, there grows on the top of a wall a plane tree, 20 feet high. Straitened for nouriſhment in that barren ſituation, it ſeveral years ago directed roots down the ſide of the wall till they reached the ground ten feet below: and now the nouriſhment it afforded to theſe roots, during the time of deſcending, is amply repaid; having every year ſince that time made vigorous ſhoots. From the top of the wall to the ſurface of the earth, theſe roots have not thrown out a ſimple fibre, but are now united into a pretty thick hard root.

“ The regular movements by which the ſun-flower preſents its ſplendid diſk to the ſun have been known to

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(B) Dr Watſon, the preſent biſhop of Landaff, who has eſpouſed the ſame ſide of the queſtion with Dr Percival (ſee the 5th vol. of his *Chemical Eſſays*), reaſons thus on the motions of vegetables. “ Whatever can produce any effect (ſays he) upon an animal organ as the impact of external bodies, heat and cold, the vapour of burning ſulphur, of volatile alkali, want of air, &c. are found to act alſo upon the plants called *ſenſitive*. But not to inſiſt upon any more inſtances, the muſcular motions of the dionæa muſcipula lately brought into Europe from America, ſeem far ſuperior in quickneſs to thoſe of a variety of animals. Now to refer the muſcular motions of ſhell-fiſh and zoophytes to an internal principle of volition, to make them indicative of the preceptivity of the being, and to attribute the more notable ones of vegetables to certain mechanical dilatations and contractions of parts occaſioned by external impulſe, is to err againſt that rule of philoſophizing which aſſigns the ſame cauſes for effects of the ſame kind. The motions in both caſes are equally accommodated to the preſervation of the being to which they belong, are equally diſtinct and uniform, and ſhould be equally derived from mechaniſm, or equally admitted as criterions of perception.

“ I am ſenſible that theſe and other ſimilar motions of vegetables may by ſome be conſidered as analogous to the automatic or involuntary motions of animals; but as it is not yet determined amongſt the phyſiologiſts, whether the motion of the heart, the periſtaltic motion of the bowels, the contractions obſervable upon external impulſe in the muſcles of animals deprived of their heads and hearts, be attributable to an irritability unaccompanied with perceptivity, or to an uneaſy ſenſation, there ſeems to be no reaſon for entering into ſo obſcure a diſquiſition; eſpecially ſince irritability, if admitted as the cauſe of the motions of vegetables, muſt *a fortiori* be admitted as the cauſe of the leſs exquiſite and diſcernible motions of beings univerſally referred to the animal kingdom.”

naturaliſts, and celebrated by poets, both of ancient and modern times. Ovid founds upon it a beautiful ſtory; and Thomſon deſcribes it as an attachment of love to the celeſtial luminary.

‘ But one, the lofty follower of the ſun,
‘ Sad when he ſets, ſhuts up her yellow leaves,
‘ Drooping all night; and when he warm returns,
‘ Points her enamour’d boſom to his ray,’

SUMMER, line 216.

Dr Percival next touches on motion; he mentions corallines, ſeapens‡, oyſters, *&c.* as endued with the power of motion in a very ſmall degree, and then he ſpeaks in the following manner. “ Mr Miller (ſays he), in his late account of the iſland of Sumatra, mentions a ſpecies of coral, which the inhabitants have miſtaken for a plant, and have denominated it *lalan-cout*, or ſea-graſs. It is found in ſhallow bays, where it appears like a ſtraight ſtick, but when touched withdraws itſelf into the ſand. Now if ſelf-moving faculties like theſe indicate animality, can ſuch a diſtinction be denied to vegetables, poſſeſſed of them in an equal or ſuperior degree? The water-lily, be the pond deep or ſhallow in which it grows, puſhes up its flower-ſtems till they reach the open air, that the farina fecundans may perform without injury its proper office. About ſeven in the morning the ſtalk erects itſelf, and the flowers riſe above the ſurface of the water: in this ſtate they continue till four in the afternoon, when the ſtalk becomes relaxed, and the flowers ſink and cloſe. The motions of the ſenſitive plant have been long noticed with admiration, as exhibiting the moſt obvious ſigns of perceptivity. And if we admit ſuch motions as criteria of a like power in other beings, to attribute them in this inſtance to mere mechaniſm, actuated ſolely by external impulſe, is to deviate from the ſoundeſt rule of philoſophizing, which directs us not to multiply cauſes when the effects appear to be the ſame. Neither will the laws of electricity better ſolve the phenomena of this animated vegetable: for its leaves are equally affected by the contact of electric and non-electric bodies; ſhow no change in their ſenſibility whether the atmoſphere be dry or moiſt; and inſtantly cloſe when the vapour of volatile alkali or the fumes of burning ſulphur are applied to them. The powers of chemical ſtimuli to produce contractions in the fibres of this plant may perhaps lead ſome philoſophers to refer them to the *vis inſita*, or irritability, which they aſſign to certain parts of organized matter, totally diſtinct from, and independent of, any ſentient energy. But the hypotheſis is evidently a ſoleciſm, and refutes itſelf. For the preſence of irritability can only be proved by the experience of irritations, and the idea of irritation involves in it that of feeling.

‡ See Pennatula, Oſtrea, Mytitus, &c.

“ But there is a ſpecies of the order of decandria, which conſtantly and uniformly exerts a ſelf-moving power, uninfluenced either by chemical ſtimuli, or by any external impulſe whatſoever. This curious ſhrub, which was unknown to Linnæus, is a native of the Eaſt Indies, but has been cultivated in ſeveral botanical gardens here. I had an opportunity of examining it in the collection of the late Dr Brown. See HEDYSARUM.—I cannot better comment on this wonderful degree of vegetable animation than in the words of Cicero. *Inanimum eſt omne quod pulſu agitatur externo; quod autem eſt animal, id motu cietur interiore et ſuo.*

“ I have thus attempted, with the brevity preſcribed by the laws of this ſociety, to extend our views of animated nature; to gratify the mind with the contemplation of multiplied acceſſions to the general aggregate of felicity; and to exalt our conceptions of the wiſdom, power, and benificence of God. In an undertaking never yet accompliſhed, diſappointment can be no diſgrace: in one directed to ſuch noble objects, the motives are a juſtification, independently of ſucceſs. Truth, indeed, obliges me to acknowledge, that I review my ſpeculations with much diffidence; and that I dare not preſume to expect they will produce any permanent conviction in others, becauſe I experience an inſtability of opinion in myſelf. For, to uſe the language of Tully, *Neſcio quomodo, dum lego, aſſentior; cum poſui librum, aſſenſio omnis illa elabitur.*—But this ſcepticiſm is perhaps to be aſcribed to the influence of habitual preconceptions, rather than to a deficiency of reaſonable proof. For beſides the various arguments which have been advanced in favour of vegetable perceptivity, it may be further urged, that the hypotheſis recommends itſelf by its conſonance to thoſe higher analogies of nature, which lead us to conclude, that the greateſt poſſible ſum of happineſs exiſts in the univerſe. The bottom of the ocean is overſpread with plants of the moſt luxuriant magnitude. Immenſe regions of the earth are covered with perennial foreſts. Nor are the Alps, or the Andes, deſtitute of herbage, though buried in deeps of ſnow. And can it be imagined that ſuch profuſion of life ſubſiſts without the leaſt ſenſation or enjoyment? Let us rather, with humble reverence, ſuppoſe, that vegetables participate, in ſome low degree, of the common allotment of vitality; and that our great Creator hath apportioned good to all living things, ‘ in number, weight, and meaſure.” See *SENSITIVE Plant*, MIMOSA, *DIONÆA Muſcipula*, *Vegetable MOTION*, *&c.*

To theſe ingenious and ſpirited obſervations, we ſhall ſubjoin nothing of our own, but leave our readers to determine for themſelves (c). Speculations of this kind, when carried on by ſober men, will never be productive of bad conſequences; but by the ſubtle ſceptic, or the more unwary inquirer, they may be made the engine of very dangerous errors. By this we do not mean to inſinuate that the ſpirit of inquiry ſhould be ſuppreſſed, becauſe that ſpirit, in the hands of weak or of wicked men, may be abuſed. By thoſe, however, who know the bad conſequences that may be drawn, and indeed that have been drawn, from the opinions we have now given an account of, our caution will not be deemed impertinent. See PHYSIOLOGY *paſſim*, and particularly nº 42, and note (A), p. 678.

(c) In the 2d volume of *Tranſactions of the Linnæan Society*, we find Dr Percival’s reaſoning very ably combated, as far as he draws his conſequences from the external motions of plants; where it is argued, that theſe motions, though in ſome reſpects ſimilar to thoſe of animals, can and ought to be explained, without concluding that they are endowed either with perception or volition. Mr Townſon concludes his paper in theſe words: “ When all is conſidered (ſays he), I think we ſhall place this opinion amongſt the many ingenious flights of the imagination, and ſoberly follow that blind impulſe which leads us naturally to give ſenſation and perceptivity to animal life, and to deny it to vegetables; and ſo ſtill ſay with Ariſtotle, and our great maſter Linnæus. *Vegetabilia creſcunt & vivant; animalia creſcunt, vivunt, & ſentiunt.*”

PLANTS growing on Animals. See *INSECTS giving root to Plants.*

Sexes of PLANTS. See SEXES, and BOTANY, ſect. v.

Colours of PLANTS. See *COLOUR of Plants.*

Colours extracted from PLANTS. See *COLOUR-making*, nº 35. *et ſeq.*

Method of Drying and Preſerving PLANTS *for Botaniſts.*—Many methods have been deviſed for the preſervation of plants: we ſhall relate only thoſe that have been found moſt ſucceſsful.

Withering's Botanical Arrangement, Introd. p. 48.

Firſt prepare a preſs, which a workman will make by the following directions. Take two planks of a wood not liable to warp. The planks muſt be two inches thick, 18 inches long, and 12 inches broad. Get four male and four female ſcrews, ſuch as are commonly uſed for ſecuring ſaſh-windows. Let the four female ſcrews be let into the four corners of one of the plants, and correſponding holes made through the four corners of the other plank for the male ſcrews to paſs through, ſo as to allow the two planks to be ſcrewed tightly together. It will not be amiſs to face the bearing of the male ſcrews upon the wood with iron plates; and if the iron plates went acroſs from corner to corner of the wood, it would be a good ſecurity againſt the warping.

Secondly, get half a dozen quires of large ſoft ſpongy paper (ſuch as the ſtationers call *bloſſom blotting paper* is the beſt), and a few ſheets of ſtrong paſteboard.

The plants you wiſh to preſerve ſhould be gathered in a dry day, after the ſun hath exhaled the dew; taking particular care to collect them in that ſtate wherein their generic and ſpecific characters are moſt conſpicuous. Carry them home in a tin-box nine inches long, four inches and a half wide, and one inch and a half deep. Get the box made of the thinneſt tinned iron that can be procured; and let the lid open upon hinges. If any thing happens to prevent the immediate uſe of the ſpecimens you have collected, they will be kept freſh two or three days in this box much better than by putting them in water. When you are going to preſerve them, ſuffer them to lie upon a table until they become limber; and then they ſhould be laid upon a paſteboard, as much as poſſible in their natural form, but at the ſame time with a particular view to their generic and ſpecific characters. For this purpoſe it will be adviſable to ſeparate one of the flowers, and to diſplay the generic character. If the ſpecific character depends upon the flower or upon the root, a particular diſplay of that will be likewiſe neceſſary. When the plant is thus diſpoſed upon the paſteboard, cover it with eight or ten layers of ſpongy paper, and put it into the preſs. Exert only a ſmall degree of preſſure for the firſt two or three days; then examine it, unfold any unnatural plaits, rectify any miſtakes, and, after putting freſh paper over it, ſcrew the preſs harder. In about three days more ſeparate the plant from the paſteboard, if it is ſufficiently firm to allow of a change of place; put it upon a freſh paſteboard, and, covering it with freſh bloſſom-paper, let it remain in the preſs a few days longer. The preſs ſhould ſtand in the ſun-ſhine, or within the influence of a fire.

When it is perfectly dry, the uſual method is to faſten it down, with paſte or gum-water, on the right-hand inner page of a ſheet of large ſtrong writing-paper. It requires ſome dexterity to glue the plant neatly down, ſo that none of the gum or paſte may appear to defile the paper. Preſs it gently again for a day or two, with a half ſheet of bloſſom-paper betwixt the folds of the writing-paper. When it is quite dry, write upon the left-hand inner page of the paper the name of the plant; the ſpecific character; the place where, and the time when, it was found; and any other remarks you may think proper. Upon the back of the ſame page, near the fold of the paper, write the name of the plant, and then place it in your cabinet. A ſmall quantity of finely powdered arſenic, or corroſive ſublimate, is uſually mixed with the paſte or gum-water, to prevent the devaſtations of inſects; but the ſeeds of ſtaves-acre finely powdered will anſwer the ſame purpoſe, without being liable to corrode or to change the colour of the more delicate plants. Some people put the dried plants into the ſheets of writing paper, without faſtening them down at all; and others only faſten them by means of ſmall ſlips of paper, paſted acroſs the ſtem or branches. Where the ſpecies of any genus are numerous, and the ſpecimens are ſmall, ſeveral of them may be put into one ſheet of paper.

Another more expeditious method is to take the plants out of the preſs after the firſt or ſecond day; let them remain upon the paſteboard; cover them with five or ſix leaves of bloſſom paper, and iron them with a hot ſmoothing iron until they are perfectly dry. If the iron is too hot, it will change the colours; but ſome people, taught by long practice, will ſucceed very happily. This is quite the beſt method to treat the orchis and other ſlimy mucilaginous plants.

Another method is to take the plants when freſh gathered, and, inſtead of putting them into the preſs, immediately to faſten them down to the paper with ſtrong gum water: then dip a camel-hair pencil into ſpirit-varniſh, and varniſh the whole ſurface of the plant two or three times over. This method ſucceeds very well with plants that are readily laid flat, and it preſerves their colours better than any other. The ſpirit varniſh is made thus. To a quart of highly rectified ſpirit of wine put five ounces of gum ſandarach; two ounces of maſtich in drops; one ounce of pale gum elemi, and one ounce of oil of ſpike-lavender. Let it ſtand in a warm place, and ſhake it frequently to expedite the ſolution of the gums.

Where no better convenience can be had, the ſpecimens may be diſpoſed ſyſtematically in a large folio book; but a vegetable cabinet is upon all accounts more eligible. In Plate CCCXCVII. there is a ſection of a cabinet, in the true proportions it ought to be made, for containing a complete collection of Britiſh plants. By the aſſiſtance of this drawing, and the adjoining ſcale, a workman will readily make one. The drawers muſt have backs and ſides, but no other front than a ſmall ledge. Each drawer will be 14 inches wide, and 10 inches from the back to the front, after allowing half an inch for the thickneſs of the two ſides, and a quarter of an inch for the thickneſs of the back. The ſides of the drawers, in the part next the front, muſt be ſloped off in a ſerpentine line, ſomething like what the workmen call an *ogee*. The bottoms of the drawers muſt be made to ſlide in grooves cut in the uprights, ſo that no ſpace may be loſt betwixt drawer and drawer. After allowing a quarter of an inch for the thickneſs of the bottom of each drawer, the clear perpendicular ſpace in each muſt be as in the following table.

I.	Two tenths of an inch.
II.	One inch and two tenths.
III.	Four inches, and ſix tenths.
IV.	Two inches and three-tenths.
V.	Seven inches and eight tenths
VI.	Two inches and two-tenths.
VII.	Two tenths of an inch.
VIII.	One inch and four-tenths.
IX.	Two-tenths of an inch.
X.	Two inches and eight-tenths
XI.	One inch and two-tenths.
XII.	Three inches and five-tenths,
XIII.	Two inches and four-tenths.
XIV.	Three inches and eight tenths.
XV.	Three inches and four tenths.
XVI.	One inch and three tenths.
XVII.	Two inches and eight tenths.
XVIII.	Six tenths of an inch.
XIX.	Ten inches
XX.	One inch and nine-tenths.
XXI.	Four inches and four tenths.
XXII.	Two inches and ſix-tenths.
XXIII.	One inch and two-tenths.
XXIV.	Seventeen inches.

This cabinet ſhuts up with two doors in front; and the whole may ſtand upon a baſe, containing a few drawers for the reception of duplicates and papers.

Foſſil PLANTS. Many ſpecies of tender and herbaceous plants are found at this day, in great abundance, buried at conſiderable depths in the earth, and converted, as it were, into the nature of the matter they lie among; foſſil wood is often found very little altered, and often impregnated with ſubſtances of almoſt all the different foſſil kinds, and lodged in all the ſeveral ſtrata, ſometimes firmly imbedded in hard matter; ſometimes looſe: but this is by no means the caſe with the tenderer and more delicate ſubjects of the vegetable world. Theſe are uſually immerſed either in a blackiſh ſlaty ſubſtance, found lying over the ſtrata of coal, elſe in looſe nodules of ferruginous matter of a pebble-like form, and they are always altered into the nature of the ſubſtance they lie among: what we meet with of theſe are principally of the fern kind; and what is very ſingular, though a very certain truth, is, that theſe are principally the ferns of American growth, not thoſe of Europe. The moſt frequent foſſil plants are the polypody, ſpleenwort, oſmund, trichomanes, and the ſeveral larger and ſmaller ferns; but beſides theſe there are alſo found pieces of the equiſetum or horſe-tail, and joints of the ſtellated plants, as the clivers, madder, and the like; and theſe have been too often miſtaken for flowers; ſometimes there are alſo found complete graſſes, or parts of them, as alſo reeds, and other watery plants; ſometimes the ears of corn, and not unfrequently the twigs or bark, and impreſſions of the bark, and fruit of the pine or fir kind, which have been, from their ſcaly appearance, miſtaken for the ſkins of fiſhes; and ſometimes, but that very rarely, we meet with moſſes and ſea-plants.

Many of the ferns not unfrequently found, are of very ſingular kinds, and ſome ſpecies yet unknown to us; and the leaves of ſome appear ſet at regular diſtances, with round protuberances and cavities. The ſtones which contain theſe plants ſplit readily, and are often found to contain, on one ſide, the impreſſion of the plant, and on the other the prominent plant itſelf: and, beſide all that have been mentioned, there have been frequently ſuppoſed to have been found with us ears of common wheat, and of the maize or Indian corn; the firſt being in reality no other than the common endmoſt branches of the firs, and the other the thicker boughs of various ſpecies of that and of the pine kind, with their leaves fallen off; ſuch branches in ſuch a ſtate cannot but afford many irregular tubercles and papillæ, and, in ſome ſpecies, ſuch as are more regularly diſpoſed.

Theſe are the kinds moſt obvious in England; and theſe are either immerſed in the ſlaty ſtone which conſtitutes whole ſtrata, or in flatted nodules, uſually of about three inches broad, which readily ſplit into two pieces on being ſtruck.

They are moſt common in Kent, on coal-pits near Newcaſtle, and the foreſt of Dean in Glouceſterſhire; but are more or leſs found about almoſt all the coal-pits, and many of the iron mines. Though theſe ſeem the only ſpecies of plants found there yet in Germany there are many others, and thoſe found in different ſubſtances. A whitiſh ſtone, a little harder than chalk, frequently contains them: they are found alſo often in a grey ſlaty ſtone of a firmer texture, not unfrequently in a blackiſh one, and at times in many others. Nor are the bodies themſelves leſs various here than the matter in which they are contained: the leaves of trees are found in great abundance, among which thoſe of the willow, poplar whitethorn, and pear trees, are the moſt common; ſmall branches of box, leaves of the olive-tree, and ſtalks of garden thyme, are alſo found there; and ſometimes ears of the various ſpecies of corn, and the larger as well as the ſmaller moſſes in great abundance.

Theſe ſeem the tender vegetables, or herbaceous plants, certainly found thus immerſed in hard ſtone, and buried at great depths in the earth: others of many kinds there are alſo named by authors; but as in bodies ſo imperfect errors are eaſily fallen into, theſe ſeem all that can be aſcertained beyond mere conjecture.

PLANTS, *method of preſerving them in their original ſhape and colour*. Waſh a ſufficient quantity of fine ſand, ſo as perfectly to ſeparate it from all other ſubſtances; dry it; paſs it through a ſieve to clear it from any groſs particles which would not riſe in the waſhing; take an earthen veſſel of a proper ſize and form, for every plant and flower which you intend to preſerve; gather your plants and flowers when they are in a ſtate of perfection, and in dry weather, and always with a convenient portion of the ſtalk: heat a little of the dry ſand prepared as above, and lay it in the bottom of the veſſel, ſo as equally to cover it; lay the plant or flower upon it, ſo as that no part of it may touch the ſides of the veſſel: ſift or ſhake in more of the ſame ſand by little and little upon it, ſo that the leaves may be extended by degrees, and without injury, till the plant or flower is covered about two inches thick: put the veſſel into a ſtove, or hothouſe, heated by little and little to to the 50th degree; let it ſtand there a day or two, or perhaps more, according to the thickneſs and ſucculence of the flower or plant; then gently ſhake the ſand out upon a ſheet of paper, and take out the plant, which you will find in all its beauty, the ſhape as elegant, and the colour as vivid as when it grew.

Some flowers require certain little operations to preſerve the adherence of their petals, particularly the tulip; with reſpect to which it is neceſſary, before it is buried in the ſand, to cut the triangular fruit which riſes in the middle of the flower; for the petals will then remain more firmly attached to the ſtalk.

A hortus ſiccus prepared in this manner would be one of the moſt beautiful and uſeful curioſities that can be.

Moving PLANT. See HEDYSARUM.

Sea PLANTS. See *SEA Plants*.

Senſitive PLANT. See MIMOSA and *SENSITIVE Plant*.

PLANT-Lice, Vine-fretters, or *Pucerons*. See APHIS.

PLANTA, a PLANT. See PLANT.

PLANTS Fœminea, a female plant, is one which bears female flowers only. It is oppoſed to a *male* plant, which bears only male flowers; and to an *androgynous* one, which bears flowers of both ſexes. Female plants are produced from the ſame ſeed with the male, and arrange themſelves under the claſs of diœcia in the ſexual method.

PLANTAGENET, the ſurname of the kings of England from Henry II. to Richard III. incluſive. Antiquarians are much at a loſs to account for the origin of this name; and the beſt derivation they can find for it is, that Fulk, the firſt earl of Anjou of that name, being ſtung with remorſe for ſome wicked action, went in pilgrimage to Jeruſalem as a work of atonement; where, being ſoundly ſcourged with broom twigs, which grew plentifully on the ſpot, he ever after took the ſurname of *Plantagenet* or *broomſtalk*, which was retained by his noble poſterity.

PLANTAGO, PLANTAIN; a genus of the monogynia order, belonging to the tetrandria claſs of plants. To this genus Linnæus has joined the coronopus and pſyllium of Tournefort. The firſt of theſe is called *hartſhorn*, the latter *fleawort*. Of theſe there are ſeveral diſtinct ſpecies, and ſome varieties; but as they are rarely cultivated in gardens, we ſhall not enumerate them here, and ſhall only mention ſuch of them as grow naturally in Britain. Of the plantain there are the following ſorts: The common broad leaved plantain, called *weybread*; the great hoary plantain, or lambs-tongue; the narrow-leaved plantain, or ribwort: and the following varieties have alſo been found in England, which are accidental; the beſom-plantain and roſe-plantain. The plantains grow naturally in paſtures in moſt parts of England, and are frequently very troubleſome weeds. The common plantain and ribwort plantain are both uſed in medicine, and are ſo well known as to need no deſcription. They are ſaid to be ſlightly aſtringent; and the green leaves are commonly applied to freſh wounds by the common people.

Of the coronopus, or buckſhorn plantain, there are two varieties growing in England, viz. the common buckſhorn, which grows plentifully on heaths everywhere; and the narrow-leaved Welch ſort, which is found upon many of the Welch mountains. The firſt of theſe was formerly cultivated as a ſalad herb in gardens, but has been long baniſhed from thence for its rank diſagreeable flavour; it is ſometimes uſed in medicine.—There has been one ſpecies of pſyllium or fleawort found growing naturally in England, which is uſed in medicine. It was found in the earth thrown out of the bottom of the canals which were dug for the Chelſea waterworks, where it grew in great plenty. The ſeeds of it muſt have been buried there ſome ages; for no perſon remembers any of the plants growing in that neighbourhood before. The ſeeds of this ſpecies are ſometimes uſed, as they are imported from the ſouth of France.

PLANTAIN. See PLANTAGO.

PLANTAIN-Tree. See MUSA.

PLANTATION, in the Weſt Indies, denotes a ſpot of ground which a planter, or perſon arrived in a new colony, pitches on to cultivate for his own uſe, or is aſſigned for that purpoſe. However, the term *plantation* is often uſed in a term ſynonymous with colony. See COLONY.

PLANTERSHIP, in a general ſenſe, the buſineſs of a planter.

PLANTERSHIP, in the Weſt Indies, denotes the management of a ſugar plantation, including not only the cultivation of the cane, but the various proceſſes for the extraction of the ſugar, together with the making of ſugar-ſpirits. See RUM, SACCHARUM, and SUGAR.

To effect a deſign ſo comprehenſive, it is neceſſary for a planter to underſtand every branch of the art preciſely, and to uſe the utmoſt attention and caution both in the laying down and executing of his plans. It is therefore the duty of a good planter to inſpect every part of his plantation with his own eyes; to place his proviſions, ſtores, and utenſils, in regular order, and in ſafe repoſitories; that by preſerving them in perfection, all kinds of waſte may be prevented.

But as negroes, cattle, mules, and horſes, are as it were the nerves of a ſugar plantation, it is expedient to treat that ſubject with ſome accuracy.

Of Negroes, Cattle, &c.] In the firſt place, then, as it is the intereſt of every planter to preſerve his negroes in health and ſtrength; ſo every act of cruelty is not leſs repugnant to the maſter's real profit, than it is contrary to the laws of humanity: and if a manager conſiders his own eaſe and his employer's intereſt, he will treat all negroes under his care with due benevolence; for good diſcipline is by no means inconſiſtent with humanity; on the contrary, it is evident from experience, that he who feeds his negroes well, proportions their labour to their age, ſex, and ſtrength, and treats them with kindneſs and good nature, will reap a much larger product, and with infinitely more eaſe and ſelf-ſatisfaction, than the moſt cruel taſkmaſter, who ſtarves his negroes, or chaſtiſes them with undue ſeverity. Every planter then who wiſhes to grow rich with eaſe, muſt be a good economiſt; muſt feed his negroes with the moſt wholeſome food, ſufficient to preſerve them in health and vigour. Common experience points out the methods by which a planter may preſerve his people in health and ſtrength. Some of his moſt fruitful land ſhould be allotted to each negro in proportion to his family, and a ſufficient portion of time allowed for the cultivation of it; but becauſe ſuch allotment cannot in long droughts produce enough for his comfortable ſupport, it is the incumbent duty

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duty of a good planter to have always his ſtores well filled with Guinea corn, yams, or eddoes, beſides potatoes growing in regular ſucceſſion: for plenty begets cheerfulneſs of thear, as well as ſtrength of body; by which more work is effected in a day by the ſame hands than in a week when enervated by want and ſeverity. Scanty meals may ſuſtain life; but it is evident, that more is requiſite to enable a negro or any other perſon to go through the neceſſary labours. He, therefore, who will reap plentifully, muſt plant great abundance of proviſions as well as ſugar-canes; and it is nature's economy ſo to fructify the ſoil by the growth of yams, plantains, and potatoes, as to yield better harveſts of ſugar, by that very means, than can be produced by many other arts of cultivation. Plantains are the principal ſupport of all the negroes in Jamaica; and are alſo much cultivated, at great expence of manure, in Barbadoes; but ought not to be ſolely depended upon in climates ſubject to hurricanes. A celebrated planter and economiſt of the laſt mentioned iſland, who raiſed an immenſe fortune from very ſmall beginnings only by planting, affirmed, that he fed conſtantly at leaſt 300 negroes out of 12 acres of plantains. How that excellent produce came to be ſo long neglected in ſome of the iſlands it is hard to gueſs; but at preſent the neglect ſeems to be founded upon a vulgar error, that plantains cannot thrive in any other than low moiſt ſoils. In ſuch places, do doubt, they flouriſh moſt luxuriantly; but yet they thrive and bear fruit abundantly on mountains and in marſhes, and in the drieſt black mould upon marle or rocks, and even in ſharp gravelly ſoils, as may be evinced by numberleſs inſtances.

However plenty of wholeſome food may be conducive to health, there are alſo other means, equally neceſſary to ſtrength and the longevity of negroes, well worth the planter's attention: and thoſe are, to chooſe airy dry ſituations for their houſes; and to obſerve frequently that they be kept clean, in good repair, and perfectly water-tight; for naſtineſs, and the inclemencies of weather, generate the moſt malignant diſeaſes. If theſe houſes are ſituated alſo in regular order, and at due diſtances, the ſpaces may at once prevent general devaſtations by fire, and furniſh plenty of fruits and potherbs, to pleaſe an unvitiated palate, and to purify the blood. Thus then ought every planter to treat his negroes with tenderneſs and generoſity, that they may be induced to love and obey him out of mere gratitude, and become real good beings by the imitation of his behaviour; and therefore a good planter, for his own eaſe and happineſs, will be careful of ſetting a good example.

Having thus hinted the duties of a planter to his negroes, let the next care be of cattle, mules, and horſes. The planters of Barbadoes (who are perhaps the moſt ſkilful of all others, and exact to a nicety in calculations of profit and loſs), are, with reſpect to their cattle, the moſt remiſs of any in all the iſlands; as if the carriage of canes to the mill, and of plantation-produce to the market, was not as eſſential as any other branch of planterſhip. At Barbaboes, in particular, the care of theſe animals is of more importance; becauſe the ſoil, worn out by long culture, cannot yield any produce without plenty of dung. Some planters are nevertheleſs ſo ingeniouſly thrifty, as to carry their canes upon negroes heads; acting in that reſpect diametrically oppoſite to their own apparent intereſt, which cannot be ſerved more effectually than by ſaving the labour of human hands, in all caſes where the labour of brutes can be ſubſtituted; and for that end, no means of preſerving thoſe creatures in health and ſtrength ought to be neglected.

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The firſt care therefore is to provide plenty and variety of food. In crop-time, profuſion of cane-tops may be had for the labour of carriage; but they will be more wholeſome and nutritious if tedded like hay by the ſun's heat, and ſweated by laying them in heaps a few days before they are eaten. In this ſeaſon of abundance, great ricks of cane-tops (the butt ends turned inwards) ſhould be made in the moſt convenient corner of each field, to ſupply the want of paſturge and other food: and theſe are very wholeſome if chopped into ſmall parts, and mixed ſometimes with common ſalt or ſprinkled with melaſſes mixed with water: but yet the cattle require change of food to preſerve them in ſtrength; ſuch as Guinea corn, and a variety of graſs, which every ſoil produces with a little care in moiſt weather; and indeed this variety is found neceſſary in all climes.

But ſince that variety is not to be had during thoſe ſevere droughts to which hot climates are liable, and much leſs in thoſe ſmall iſlands which cannot furniſh large tracts of meadow-lands for hay, the only reſource is the fodder of cane tops or tedded Guinea-corn leaves; which are very nutritious, and may be preſerved in perfection for more than a whole year, provided the tops of Guinea-corn are well tedded for three or four hot days as they lie ſpread in the field; and then, being tied into bundles or ſheaves, muſt lie in the hot ſun for three or four days more, when they may be fit to be put up into ricks. The beſt method of making them is in an oblong figure, about 30 feet in length, and 16 or 18 feet wide; ſeven feet high at the ſides, and from thence ſloping like the roof of an houſe, the ridge of which muſt be thatched very carefully; for the ſides may be ſecured from wet by placing the bundles with the butts upwards towards the ridge, in courſes, and lapping the upper over the lower courſe.

The beſt method of forming thoſe ricks is to place the firſt courſe of bundles all over the baſe one way; the ſecond courſe reverſely; and ſo alternately till the rick be finiſhed.

When cattle are to be fed with this fodder, it muſt be obſerved to take down the bundles from the top, at the weſt end of the rick, to the bottom; for all theſe ricks muſt ſtand eaſt and weſt lengthwiſe, as well to ſecure them from being overturned by high winds, as for the convenience of preſerving them from wet, which cannot be done when ricks are made round. By this huſbandry, an herd of cattle may be kept in ſtrength, either in ſevere droughts, or in wet ſeaſons when graſs is purgative; and thus the neceſſity or expence of large paſtures may be totally ſaved. The hay-knife uſed in England for cutting hay, anſwers for cutting ricks of tops.

The method of tedding Guinea-corn to make a kind of hay, will require a little explanation here. When Guinea corn is planted in May, and to be cut down in July, in order to bear ſeed that year, that cutting, tedded properly, will make an excellent hay, which cattle prefer to meadow-hay. In like manner, after Guinea-corn has done bearing ſeed, the after crop will furniſh a

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great abundance of that kind of ſodder which will keep well in ricks for two or three years.

The next care of a planter is to provide ſhade for his cattle; either by trees where they are fed in the heat of the day, if his ſoil requires not dung; or by building a flat ſhade over the pen where cattle are confined for making it. That ſuch ſhades are eſſentially neceſſary to the well-being of all animals in hot weather, is apparent to every common obſerver, who cannot fail of ſeeing each creature forſaking the moſt luxuriant paſtures in the heat of the day for the ſake of ſhade; thus convincing the owners, by inſtinctive argument, that ſhade is almoſt as neceſſary to the well-being of the brute creatures as food. Yet, notwithſtanding that demonſtration from the unerring courſe of nature, throughout all the Britiſh iſlands (except in a very few inſtances) theſe poor creatures are expoſed to the ſcorching ſun-beams without mercy. Such inhuman neglect is not always ſo much the effect of inattention as of a miſtaken notion that ſhades are impedimental to the making of much dung; but a flat ſhade, covered with cane-traſh, may be ſo made as to let rain paſs through it without admiſſion of ſun-beams. This will do for cattle; but mules, which are ſpirited creatures, and work themſelves by draught into a foaming heat, ſhould be put into a warm ſtable, until quite cool: for turning them looſe to paſture when ſo hot, is probably the cauſe of their deſtruction by the glanders.

If the care of providing ſhade for brute creatures is ſo much the duty and intereſt of their owners, how much more is it agreeable to the laws of humanity to provide ſhade for human creatures travelling upon the high-roads in this hot climate? Nothing ſurely of ſo much beauty coſts ſo little expence as planting cocoa-nut or ſpreading timber trees in avenues along the highways, if each proprietor of the lands adjoining hath any taſte of elegance, or feeling for other men: but both thoſe kinds of trees will yield alſo great profit to the proprietor, by furniſhing him with timber, when perhaps not otherwiſe to be had; or with a delicious milk, fitted by nature to cool the efferveſcence of the blood in this hot region; and alſo to improve the ſpirits made from ſugar to the delicacy and ſoftneſs of arrack. Cocoa-nut and cabbage trees are both very beautiful and ſhady, bearing round heads of great expanſion, upon natural trunks or pillars of elegant proportion, and of ſuch an height as to furniſh a large ſhade, with a free circulation of air equally refreſhing to man and beaſt.

The common objection of injury to canes by the roots of ſuch trees growing on their borders, may be eaſily removed by digging a ſmall trench between the canes and trees, which may intercept their roots, and oblige them to ſeek ſuſtenance in the common road. Let it alſo be conſidered, beſides the benefits above ſuggeſted, that the planter will thus beautify his eſtate to the reſemblance of a moſt ſumptuous garden. And probably that very beauty might not only render the iſlands more healthful to the inhabitants, by preſerving them from fevers kindled by the burning ſun-beams, but alſo much more fruitful by making the weather more ſeaſonable: for as, by cutting down all its woods, an hot country becomes more ſubject to exceſſive droughts; ſo, by replanting it in the manner above deſcribed, this inconvenience would probably be prevented.

Let then the planter be kind not only to his fellow-creatures but merciful to his beaſts; giving them plenty and variety of wholeſome food, clear water, cool ſhade, and a clean bed, bleeding them after a long courſe of hard labour, currying their hides from filth and ticks (A); affording them ſalt and other phyſic when neceſſary; protecting them from the flaying rope-laſhes of a cruel driver (who needs no other inſtrument than a goad); proportioning their labour to their ſtrength; and by every art rendering their work as eaſy as poſſible. The general management of planters is not, perhaps, more defective in any other reſpect than in this: for, by pairing the cattle unequally, and by the drivers ill conduct in writhing to the right and left, the poor creatures are fatigued by much needleſs labour. An horſe ought therefore to be harneſſed before them as a leader. This docile creature, by being led in a ſtraight line, will ſoon learn to be an unerring guide, and the cattle will follow in the ſame direction with united ſtrength, and conſequently with more effect and leſs fatigue to each individual.

The Portugueſe of Madeira, by their poverty and ſcantineſs of paſture, breed the ſmalleſt kind of cattle; and yet one yoke of them will draw a much greater weight than a pair of the largeſt Britiſh oxen, ſolely by an equal exertion of their joint ſtrength. That equality or evenneſs of draught is preſerved by boring gimblet holes through their horns, within two inches of the points, and running a thong of leather through thoſe holes, ſo as to tie the horns of each pair at ſix inches diſtance from each other. By this ligature the pair of cattle are abſolutely hindered from turning different ways, and draw in an even direction with united force. Thus it appears evidently from reaſon, as well as from experience, that the labour of the Britiſh beaſts may, by a little contrivance, be rendered more eaſy and effectual.

Of the culture of various Soils.] In the Britiſh ſugar-colonies there is as great a variety of ſoils as in any country of Europe; ſome naturally very rich or fruitful, yielding a luxuriant product with little labour or culture. This fruitful ſoil is of three kinds; a looſe hazel mould mixed with ſand, like that of St Chriſtopher's, and is the beſt in the known world for producing ſugar in great quantity, and of the beſt quality. The brick mould of Jamaica is ſomewhat of the ſame nature, and next in value; and then the various mixtures of mould and gravel, to be found in veins or plats over all the other iſlands. When any of theſe ſoils are exhauſted of their fertility by long and injudicious culture, they may be reſtored by any kind of dung well rotted; for theſe (B) warm ſoils cannot bear hot unrotten dung, without being laid fallow for a conſide-

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(A) One pound of native ſulphur, a quart of lamp-oil, and the like quantity of hog's-lard, intimately mixed and made into an ointment, is a cure for the mange, lice, &c.

(B) Theſe ſoils, which are naturally looſe and upon Marle, Mr Martin calls *hot ſoils*; and theſe, he ſays, have able time after it. Another improvement is by ſea-ſand or ſea-weed; or by digging in the cane-traſh into ſteep lands, and by letting it lie to rot for ſome months. A third method is, by ploughing and laying it fallow; and the fourth method (the beſt of all), is by folding the fallows by ſheep. But this can be practiſed only where there are extenſive paſtures; nor can the plough be employed where the ſoil abounds with large ſtones. In that caſe, however, the former method of digging in traſh will be nearly as effectual, though more expenſive, by hand-labour or hoe-ploughing.

The next beſt ſoil for producing good ſugar is a mould upon clay, which if ſhallow requires much culture and good labour, or its produce will be ſmall in quantity, though of a ſtrong grain and bright colour, ſo as to yield moſt profit to the refiner of any ſugar, except that produced from an hazel or gravelly ſoil, as before-mentioned. All the black mould ſoils upon marle are generally fruitful, and will take any kind of dung; but yield not ſo ſtrong or large-grained ſugar. Marle, however of a white, yellow, or blue colour, or rich mould from waſhes, or aſhes of every kind, are excellent for every ſtrong ſoil, as the chief ingredient in the compoſt of dung; either of them will do alone for ſtiff lands; but the yellow and chocolate marle are the moſt ſoapy, and the richeſt kind of manure (except fine mould) for all ſtiff lands. If theſe are well opened, pulverized by culture, and mixed with hot dung, or any kind of looſe earth or marle, they will produce as plentifully as lighter ſoils: and all kinds of clay-ſoils, except that of a white colour, have theſe two advantages above the fineſt gravel ſoils, that they do not ſcorch ſoon by dry weather, and never grow weary of the ſame manure, as moſt other ſoils do.

The extraordinary hand-labour beſtowed in making dung, may be ſaved by the art of caving, now in general uſe in England. Ten mules or horſes, and two light tumbrels with broad wheels, and ten able negroes, may, by the common uſe of ſpades, ſhovels, and light mattocks, or grubbing hoes, make more dung than 60 able negroes can do in the preſent methods.

If marle lies upon riſing ground, or in hillocks, as it often does, the pit is to be opened at the foot of the declivity; which being dug inwards, till the bank is three feet high, then it is to be *caved* thus. Dig an hollow ſpace of 12 or 18 inches deep under the foot of the bank; then dig into each ſide of it another perpendicular cut of the ſame depth, and 18 inches wide from the top of the bank to the bottom: that being finiſhed, make a ſmall trench a foot or two from the brink of the bank; pour into it water till full; and when that is done, fill it again, till the water ſoaking downward makes the marle ſeparate and fall down all at once. This may be repeated till the pit riſes to 50 feet high; and then many hundreds of cart-loads of marle may be thrown down by four negroes in two hours; from whence it may be carted into cattle-pens or laid out upon lands, as occaſion requires. Five or ſix negroes with ſpades or ſhovels will keep two or three tumbrels employed, according to the diſtance of cartage: and thus as much dung may be made by ten negro men as will dung richly at leaſt 70 or 80 acres of land every year, and laid out alſo with the aſſiſtance of cattle-carts: An improvement highly worth every planter's conſideration, when negroes and feeding them are ſo expenſive; and this is no ſpeculation, but has been confirmed by practice. In level lands, the ſame operation may be as effectual, provided the mouth of the pit be opened by gradual deſcent to any depth: but when marle is to be found on the ſides of hills, the operation is leſs laborious for the horſes. But if the ſurface of the marle-pits (as it often happens) be covered with clay or ſtiff ſoil, ſo that the water cannot quickly ſoak from the trench above; in that caſe, pieces of hard wood, made like piles, four feet long, and four inches ſquare, pointed at one end, and ſecured at the other ſquare head by an iron clamp, may be driven by heavy mauls into the trench, as ſo many wedges, which will make the caved part tumble down: but a ſkilful eye muſt watch the laſt operation, or the labourers may be buried or hurt.

But then clay-ſoils that are level, and ſubject to be drowned, or to retain water in ſtagnated pools, can never be made fruitful by any kind of manure, without being firſt well drained: for water lying upon any ſoil will moſt certainly transform it to a ſtiff unfruitful clay; as appears evidently by the bogs of Ireland, the fens of Lincoln and Cambridgeſhire, and even by the ponds of Barbadoes ſituated in the deepeſt and lighteſt black mould; for that fine ſoil being waſhed into thoſe ponds, becomes the ſtiffeſt black clay, not fit even for an ingredient in dung, until it has been laid dry, and expoſed to the ſun for a whole year: but when theſe bogs and fens are well drained, they become the moſt fruitful ſoils. Natural clay the celebrated Boerhaave thinks the fatteſt of all ſoils; but then it muſt be opened by culture, marle, or ſandy manures. It is hard to conjecture how the opinion prevailed in the Britiſh plantations, that ſandy gut-mould was moſt unfit for clay-ſoils, as being the means of binding them to the compactneſs of brick; whereas it is proved, from long experience, to be one of the beſt means of opening clay ſoils, and rendering them abundantly fruitful. Brick is made of *clay alone;* no ſand being uſed in it, farther than to ſprinkle the board, on which it is moulded into ſhape. From repeated experience it appears, that a mixture of ſand in gut-mould is the beſt of all manure for ſtiff and barren clay-lands; provided they be well drained, by throwing the whole ſoil into round ridges of 12 feet wide, with furrows of three feet wide between each ridge. And this is done with little more hand labour than that of hoe-ploughing well in the common way. For if a piece of land be marked in lines at ſeven feet and a half diſtance from each other, and the labourers are ſet in to hoe-plough at the ſecond line, hauling back each clod 12 inches; half the ridge, and near half the furrow, is made at the ſame time: and thus a piece of land may be round-ridged, and the furrows all made at once, by the common operation of hoe-ploughing, provided the digger drives his hoe up to the eye at every ſtroke. Hoe-ploughing

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been much injured in ſome of the iſlands by dung haſtily made with marle: but if the ſediment of lees were thrown into theſe pens, after being turned over, it would much improve the dung.

Planter-ſhip.

ploughing in clay-ſoils that have lain long under water, is indeed hard labour; but it will every year grow the lighter by being well-drained by round-ridging: and in the meanwhile the labour may be rendered much more eaſy by the plough conducted by the lines above deſcribed. As therefore ſandy mould is the beſt manure for ſtiff clay; ſo, by parity of reaſon, confirmed by long experience, ſtiff clay is the beſt manure for ſandy or chaffy ſoils.

The method of round-ridging before deſcribed, is, by ſeveral years experience, found the moſt eſſential improvement of flat clayey ſoils: and yet there are ſome who will prefer ſpeculation to ocular demonſtration, fancying that all kind of ridges will carry off the mould in heavy rains. The fact is otherwiſe in clay-ſoils: and plain reaſon, without experience, vouches, that where great confluxes of water are divided into many ſmall rills, the force is broken; and therefore leſs mould carried off the land. Another objection made to round-ridging is, that by digging much clay to form the ſides of the ridge, the ſoil is impoveriſhed: but this objection ſtands good only againſt thoſe ridges which are raiſed too high, and made too broad; but if land is ridged in the manner before directed, that is, 12 feet broad, and not above ſix or eight inches higher in the middle than at the ſides, the objection vaniſhes. Ridges were never propoſed for light ſoils or ſteep lands; and even in flat ſoils upon loam they ſhould be made with great caution, becauſe *loam melts away by water.* But there are poachy lands of a white clay, even upon ſmall deſcents, too retentive of water; theſe may certainly be improved much by ridges of 12 feet wide, as above deſcribed, without fear of waſhes.

But ſuppoſing, as the objection urges, that a little clay ſhould be turned up at the ſides of ſuch ridges, can it not be manured ſomewhat more than the other parts with marle or ſandy mould, ſo as to become equally good with any other part of the ſoil? and is not this well worth the labour, ſince round-ridging not only improves the ſoil by draining it to a ſurpriſing degree, but adds one-fifth part to the depth of the ſtaple? And will not a ridge made a little rounding, throw off the water much better than a flat ridge?

The general maxim of not burning cane-traſh (which may be called the *ſtubble of cane-lands*) upon any kind of ſoil, is ſurely a great miſtake; as may be evinced by obſerving the contrary practice of the beſt huſbandmen in England, where burn-baiting or baſtard burn-baiting, is found by experience an admirable method of fertilizing cold, ſtiff, or clayey lands. It muſt indeed be a conſtant practice, not only for the ſake of contributing to warm and divide the ſoil, but as the only effectual means of deſtroying pernicious inſects, and weeds of various kinds, ſuch as French weed, wild peaſe, and wild vines.

Soon after the diſuſe of burning traſh upon the lands in the iſlands, the blaſt made its firſt appearance with incredible devaſtation: to revive that practice therefore ſeems to be the moſt obvious means of expelling it. It may be preſumed that the diſuſe of burning traſh was founded upon the miſtaken notion of burn-baiting, which is turning up a thick ſod of very dry, light, and ſhallow ſoils, and burning the whole ſuperficies or ſtaple to aſhes. This practice the writers upon huſbandry condemn univerſally, and very juſtly: for though by this practice the land will produce two or three crops more plentifully than ever, yet the ſoil is blown away by the wind, and the ſubſtratum being generally an hungry gravel or chalk, can never be reſtored to fertility by the common arts of huſbandry. But ſurely this has no reſemblance to the ſuperficial burning of the little traſh we can ſpare from dung; and though this method of burn-baiting light and ſhallow ſoils be juſtly condemned, yet the beſt writers recommend that very practice in cold, moiſt, and heavy ſoils, as is obſerved above; and long experience juſtifies it.

Planter-ſhip.

Deep mould upon clay or loam being ſubject to the grub worm (c), will not take any kind of dung, till perfectly rotten, except that of the ſheep-fold; which is the beſt manure for all kinds of light ſoils, and is of all others the leaſt expenſive, as not requiring hand-labour. But the uſe of the fold is impracticable in any iſland not abounding with large ſavannas or ſheep paſtures, as in Jamaica.

Thoſe ſoils therefore which are ſubject to the grub, and muſt be fertilized by common dung, which is a proper neſt for the mother-beetle to depoſite its eggs, muſt be well impregnated with the brine of diſſolved ſalt, after the dung is firſt cut up; two large hogſheads of ſalt will make brine enough for a dung-pen of 50 feet ſquare.

This cure for the grub is a late diſcovery; and which has been attended with ſucceſs, ſo far as the experiment is made. But though it proves effectual to deſtroy that pernicious inſect in plant-canes, it probably will not be ſufficient to ſave rattoons, without a new application of ſalt in powder; becauſe the firſt brine muſt be waſhed away by the time when rattoons ſpring up.

The planter who would ſave his rattoons from the grub ought therefore to cut off the heads of his ſtools with ſharp hoes three inches below the ſurface of the ſoil, and then ſtrew an handful of ſalt round each ſtool, and cover it up to a level with fine mould taken from the edges.

In ſoils where there is no grub, and the planter wiſhes to have very good rattoons, let him, as ſoon as his canes are cut, draw all the traſh from the ſtools into the alternate ſpaces, if planted in that manner; or into the furrows, if his land be round-ridged; and then cut off the head of his ſtools with ſharp hoes, as above directed. Experience has ſhown the advantage of this practice, and reaſon demonſtrates the great benefit of the rattoon-ſprouts riſing from three inches below the ſurface, inſtead of ſuperficial ſhoots which come to nothing, and only ſtarve the ſtrong ſprouts. Beſides, the ſtubs which are left upon the ſtools after the canes are cut, canker, and rot the ſtools; which is one reaſon why good rattoons

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(c) This pernicious inſect is moſt apt to engender in dung made from mill-traſh, which therefore never ought to be put into dung-compoſt or ſtill ponds; but after being burnt, the aſhes will be as good as any other kind. Round-ridging, with manure of unwet aſhes, ſea-ſand, or lime, or dry marle, kills the grub.

toons are uncommon in ſoils long cultivated. Yet it is the opinion of ſome, that by hoe-ploughing and even dunging rattoons, the produce might be as good plant-canes, which would ſave the labour of holing and planting ſo often as planters commonly do.

Fallowing is of incredible advantage to every ſoil, not only by being divided into the minuteſt parts, but alſo by imbibing thoſe vegetative powers with which the air is impregnated by the bountiful hand of Providence, whenever rain falls. What thoſe powers are has been explained under the articles AGRICULTURE and PLANT; and experience evinces, that the tender vegetables of the earth are invigorated more by the ſmalleſt ſhower of rain, than by all the water which human art can beſtow. Let it therefore be a conſtant maxim of the planter, never to plant his ground until the ſoil is well mellowed by fallowing, even though he beſtows upon it a due proportion of dung: we ſay a due proportion; for too much will force up rank canes, which never yield good ſugar; and though ſome advantage may be reaped from the rattoons, yet it will be found by experience not to compenſate the loſs by the plants. In ſtony or ſteep ſoils, where the plough cannot be uſed, or where a ſufficient ſtrength of cattle cannot be ſupported for that purpoſe, hand-labour or hoe-ploughing muſt be ſubſtituted: but even in that caſe, much labour may be ſaved by ſpreading the dung according to the Engliſh huſbandy, and digging it into the ſoil. To evince this truth, let any planter compute his negroes labour of diſtributing dung by baſkets, and by ſpreading it with dung-forks; and then judge for himſelf by one ſingle experiment which is the moſt profitable.

But if ſome planters are ſo devoted to the old cuſtom of diſtributing dung by baſkets inſtead of wheel-barrows in level ground, or hand-barrows in uneven land, by which three times the labour may be accompliſhed in the ſame time and by the ſame hands; let them at leaſt ſave much of their hand-labour, by the following method of laying out dung, before the diſtribution by baſkets.

In holing a piece of land, let a ſpace be left after 80 holes from the firſt interval, and then the like ſpace after 80 holes throughout the whole plat, which ſpaces muſt run exactly parallel to the intervals on the right and left of the holes. Into theſe ſpaces the dung may be carted, even before it be rotten (D), at the moſt leiſure times, and covered with mould or cane traſh, to prevent exhalation; and in ſuch quantity as will ſuffice only to dung a row of 40 holes, from the point oppoſite to each ſide of it. In the intervals at each ſide of the cane-piece, which are parallel to thoſe ſpaces, there muſt be dung enough carted to mature a row of 40 holes, and covered in like manner.

By thus placing the dung or gut-mould, it is evident at the firſt ſight, that the fartheſt diſtance cannot be above 40 holes in diſtributing the dung; and in caſe it be not ſufficiently rotten for preſent uſe, it may be diſtributed even in dry weather, and covered by the bank; which will both prevent its ſpirit from exhalation, and occaſion it to rot ſooner, which is no ſmall advantage. Moreover, by being thus laid out at the moſt leiſure times, and covered with the banks, the dung will be more intimately mixed with the ſoil, and therefore continue to nouriſh the plant for a longer time than if laid as uſual at the bottom of the holes. A farther advantage of thus diſtributing the dung, and covering it, reſults from the more expeditious planting the land after a ſhort or ſudden ſhower: for the labour of covering the dung, and uncovering it when the land is planted, however it may appear in ſpeculation, is in practice a trifle; and beſides all the other advantages ariſing by the diſtribution of dung from the ſpaces above deſcribed, this is not the leaſt, that not a bank is trodden under foot. But it is evident, that by diſtributing the dung with baſkets in the preſent method, the ſoil is much trampled under foot; and by that means, the very end of hoe-ploughing, or looſening the ſoil is much defeated. In like manner, by the preſent method of hoe-ploughing, the ſame ill effect is produced; for as the negroes hoe-plough or dig the ſoil directly forward, ſo they muſt neceſſarily tread the ground as faſt as they dig it: whereas by putting the labourers to dig ſidewiſe, no one puts a foot upon the ſoil after it is dug; and by lining the land before it is hoe-ploughed, each negroe may have an equal ſhare to dig. The only difficulty of hoe-ploughing ſidewiſe is in firſt ſetting the negroes to that work; but it may be done without loſs of time when working in a contiguous field. Whether hoe-ploughing before or after the land be holed for canes is moſt eligible, experience muſt determine; but certainly both operations will be moſt effectual: and therefore it will be adviſable (E), firſt to plough the ſoil where the land will admit the plough; and where it will not, to hoe-plough it with or without dung, as requiſite; then let it lie fallow till perfectly mellowed; then hole and plant it; and inſtead of weeding in the uſual manner, let the weeds in all the ſpaces be dug into the ſoil: but as this is not to be done ſo well with the hoe, it is ſubmitted to future experience, whether the dexterous uſe of ſpades, as in England, will not anſwer the purpoſe much better, and with equal diſpatch. But whatever method is preferred, moſt certain it is, that by looſening the ſoil in all the ſpaces between the young canes after being come up, their fibres will more eaſily expand on every ſide, and acquire more nutrition to invigorate their growth. But where the planter grudges this labour, by thinking it needleſs in a rich looſe ſoil, he may diſpatch more weeding-work by the Dutch hoe than by any other; which being faſtened

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(D) In order to make dung rot the ſooner, much labour is beſtowed in digging and turning it over by hoes: but two-thirds of that labour may be ſaved by the uſe of hay-knives; ſix of which, uſed dexterouſly, will cut up a pen in leſs time than 60 negroes can do by hoes: but hay-knives cannot be uſed where gritty mould is uſed in pens.

(E) Deep and looſe ſoils may be ploughed with a ſmall ſtrength of cattle or mules: but ſtiff lands in hot climates require more ſtrength of cattle than can be maintained in the ſmall paſtures of the planters; for if thoſe ſtrong ſoils are either too wet or too dry (as is generally the caſe), ploughing is impracticable.

upon the end of a ſtick, is puſhed forward under the roots of the ſmall weeds, in ſuch a manner as to cut them up a little below the ſurface of the ſoil, and will do more execution at one ſhove than can be done at three ſtrokes of the common hoe: but there is yet another practice of the horſe-hoe plough, whereby all weeds growing in rows between the beans and peaſe, are extirpated with incredible eaſe and expedition. It is a very ſimple machine, drawn by one or two horſes, conſiſting of a pair of low wheels turning upon a common axis; from whence two ſquare irons are let down at equal diſtances, and triangular hoes made at the ends, the points of the triangles being placed forward, and ſo fixed as to cut all weeds an inch below the ſurface, in the ſame manner as the Dutch garden hoe above-mentioned. By this machine a man and a boy, with two horſes or mules, will clear perfectly all the ſpaces of a field of ten acres in two days, and may be of admirable uſe in all looſe and dry ſoils in the ſugar-iſlands: for while two horſes or mules draw in the ſpace before each other, the wheels paſs on the outſide of each row of canes, without doing the leaſt injury, while the plough-holder attends to his buſineſs. In ſtiff ſoils which require draining, neither the horſe-hoe plough nor the Dutch hoe can be proper; or any other inſtrument ſo effectual as the ſpade uſed in the manner above hinted where the ſtaple is deep.

But where the ſtaple of land is ſhallow, care muſt be taken not to dig much below it, according to the univerſal opinion of all the beſt writers ſupported by the experience of 100 years. Yet ſome good planters are fallen into the contrary practice, and dig up ſtiff clay far below the ſtaple. This, Mr Martin ſays, was done in his own lands, during his abſence, by injudiciouſly ploughing below the ſtaple; and ſo injured the ſoil, that all the arts of culture for many years hardly retrieved its former fertility. Indeed, where the ſtaple is ſhallow, upon a fat clay, the turning up a little of it at a time, from the bottom of the cane-holes, and mixing it with rich hot dung, made of marle, or ſandy mould, which may take off its coheſive quality, will in due time, and by long fallow, convert it into good ſoil: but if ſtiff clay be turned up, without any ſuch mixture, in large quantities, it will infallibly diſappoint the operator's hopes: for though ſolid clay will moulder, by expoſure, to a ſeeming fine earth, yet it will return to is primitive ſtate very ſoon after being wet, and covered from the external air if not divided, as above ſuggeſted.

After all, the common horſe-hoeing plough drawn by two mules in a line before each other, or the hand-hoe in common uſe, will anſwer the purpoſe very well, where the lands are planted in Mr Tull's method; that is, where the ſpaces are equal to the land planted in the following manner.

Suppoſe ſix feet planted in two rows of canes, and ſix feet of land left as a ſpace unplanted; and ſo a whole piece of land, planted in alternate double rows (F), with equal ſpaces, may be hoe-ploughed with eaſe, as before hinted; and that any time during the growth of canes, when it is moſt convenient to the planter, which is a conſiderable advantage; and yet it is the leaſt of all attending this method of culture: for, by leaving theſe ſpaces, the canes will have both more air and ſun: by hoe-ploughing them, the roots of each double row will have large room for expanſion, and conſequently, by gaining more nutriment, will grow more luxuriantly: by theſe ſpaces the canes may be cleaned from the blaſt with much more eaſe and convenience; and will ſerve as proper beds to plant great corn, without the leaſt injury to the canes; as well as to contain the traſh taken off the land, where by rotting, and being hoe ploughed into the ſoil, it will wonderfully enrich it, and will fit it to be planted immediately after the canes in the neighbouring double rows are cut down. Beſides all theſe admirable advantages of planting the land in alternate double rows with equal ſpaces, the canes, when at full age, may be eaſily ſtripped of their traſh, and by that means the juice rendered ſo mature as to yield double the produce, and much better ſugars than unſtripped canes. This method of culture may be recommended for all kinds of ſoil: for as by this practice the rank luxuriant canes will be more matured, ſo the poor ſoils will be rendered more fruitful; and as the roots of the canes which expanded into theſe ſpaces will be kept moiſt by being covered with rotten traſh, ſo they muſt bear dry weather much longer in the burning ſoils. In theſe low lands which require draining by furrows, the alternate double rows and ſpaces muſt be made croſs the ridges; by which means thoſe ſpaces, being hoe-ploughed from the centre to the ſides, will be always preſerved in a proper ſtate of roundneſs. By this method of planting, the canes may be ſo well ripened as to yield double the quantity of ſugar of canes planted in the cloſe manner; which ſaves half the labour of cartage, half the time of grinding and boiling, and half the fuel, beſides yielding finer ſugar.

Yet, how well ſoever the method of planting in ſingle or double alternate rows has ſucceeded in the looſe and ſtiff ſoils, experience has ſhown that it is a wrong practice in ſtiff lands that are thrown into round or flat ridges: for theſe being moſt apt to crack, the ſun-beams penetrate ſoon to the cane roots, ſtop their growth, and have an ill influence upon the ſugar. It is therefore adviſable to plant ſuch lands full, but in large holes, of 4 feet, by 5 feet towards the banks: after the plant-canes are cut, to dig out one and leave two rows ſtanding, hoe-ploughing the ſpaces after turning all the traſh into furrows till almoſt rotten: for if the tract is drawn upon the hoe-ploughed ſpaces, they will hardly ever moulder, at leaſt not till the traſh is quite rotten. This is an infallible proof from experience of how little advantage traſh is to the ſoil, unleſs it be in great droughts, to keep out the intenſe ſun-beams: for, in all other reſpects, it prevents that joint operation of the ſun and air in mouldering and fructifying the ſoil, as has been proved by repeated experiments.

But in flat ſtiff ſoils that are properly drained by round-ridging, no culture prevents cracking ſo effectually as hoe-ploughing into them a quantity of looſe marle, of which that of a chocolate or of a yellow colour is beſt;

(F) In ſtiff lands, the ſingle alternate rows of four feet diſtance, as preventive of much labour in weeding, are found beſt; and alſo yield more ſugar by the acre; and are leſs apt to be affected by drought.

beſt; and it will be ſtill much better, by lying upon the land, in ſmall heaps, or in cane-holes, for ſome time, to imbibe the vegetative powers of the air before it is intimately mixed with the ſoil.

As to the manner of planting canes, the general practice of allowing four feet by five to an hole, and two freſh (G) plants, is found by common experience to be right and good in alternate rows. But the following precautions are neceſſary to be obſerved. Firſt, let all the cane-rows run eaſt and weſt, that the trade-wind may paſs freely through them; becauſe air and ſunſhine are as conducive to the growth and maturation of ſugar-canes as of any other vegetable. Secondly let not any acceſſion of mould be drawn into hills round the young canes, except where water ſtagnates (H); becauſe the fibres which run horizontally and near the ſurface, are much broken and ſpoiled by that practice. Thirdly, let the ſugar-canes be cut at their full maturity; which, in a dry looſe ſoil, is generally at the end of 14 or 15 months after being planted; but in cold clay-ſoils, not till 16 or 17 months. Fourthly, as the cane-rows run eaſt and weſt in as proper a direction as poſſible for cartage to the ſugar work, ſo canes muſt be cut the contrary way if the planter expects any great produce from his rattoons: for by beginning to cut canes at the part of his field moſt remote from the works, the carts cannot often paſs over the ſame tract, and conſequently the cane-ſtools cannot be injured, more eſpecially if he takes due care to cut the canes very cloſe to their roots; for, by leaving a long ſtub (which muſt periſh) the cane-ſtools are much injured. It may be objected to the practice of the cutting canes tranſverſely to the rows, that the negroes labour will not be ſo equally divided: but let every man conſider both ſides of the queſtion, and be determined by his own experience; and then he will be convinced, that it matters very little which way he cuts ſtraight ſtanding canes; but in caſes where the ſugar-canes lean, or are lodged by preceding high winds, it is a point of great importance to place the labourers ſo as to cut the canes firſt at the roots, and then, drawing them, cut off the tops: for thus by two ſtrokes each cane will be cut; and twice the quantity cut in the ſame time, and by the ſame hands, more than by cutting in any other direction. In round-ridged land, it is proper to cut canes in the ſame direction of the ridges throwing the tops and traſh into the furrows to render the carriage eaſy and to preſerve the ridges in their proper form.

It is almoſt needleſs to ſuggeſt the expediency of planning the cane-pieces of a plantation in exact ſquares, ſo that the interval may interſect at right angles; ſince ſuch regularity is not only more beautiful, more ſafe in caſe of accidental fires, and a better diſpoſition of the whole for dividing and planting one third or fourth part of a plantation every year, but alſo much eaſier guarded by a few watchmen for one of theſe walking in a line from eaſt to weſt, and the other from north to ſouth, look through every avenue, where the moſt ſubtile thief cannot eſcape the watchful eye. And if the intervals ſurrounding the boundary of a regular plantation be made 24 feet wide, the proprietor will receive ample recompenſe for ſo much land, by the ſecurity of his canes from fires kindled in the neighbourhood, and by planting all that land in plantain-trees, which may at once yield food and ſhade to the watchmen, who by that means can have no excuſe for abſence from their proper ſtations. But as fuel grows very ſcarce in moſt of theſe iſlands, it is alſo expedient to plant a logwood or flower-fence in all the boundaries of every plantation, which being cut every year, will furniſh good ſtore of faggots. Logwood makes the ſtrongeſt and quickeſt of all fences, and agrees with every ſoil: the cuttings make excellent oven-fuel.

So much for the general operations of planterſhip, according to the approved directions of Mr Martin. For the particular cultivation of the ſugar-canes, the extraction of the ſugar, and the diſtillation of rum, ſee the articles SACCHARUM, SUGAR, and RUM.

PLANTIN (Chriſtopher), a celebrated printer, was born near Tours in 1533, and bred to an art which he carried to the higheſt degree of perfection. He went and ſettled at Antwerp; and there erected a printing-office, which was conſidered not only as the chief ornament of the town, but as one of the moſt extraordinary edifices in Europe. A great number of ancient authors were printed here; and theſe editions were valued not only for the beauty of the characters, but alſo for the correctneſs of the text, with regard to which Plantin was ſo very nice, that he procured the moſt learned men to be correctors of his preſs. He got immenſe riches by his profeſſion; which, however, he did not hoard up, but ſpent like a gentleman. He died in 1598, aged 65 years; and left a moſt ſumptuous and valuable library to his grandſon Balthaſar.

PLANTING, in agriculture and gardening, is ſetting a tree or plant, taken from its proper place, in a new hole or pit; throwing freſh earth over its root and filling up the hole to the level of the ſurface of the ground.

The firſt thing in planting is to prepare the ground before the trees or plants are taken out of the earth, that they may remain out of the ground as ſhort a time as poſſible and the next is, to take up the trees or plants, in order to their being tranſplanted. In taking up the trees, carefully dig away the earth round the roots, ſo as to come at their ſeveral parts to cut them off; for if they are torn out of the ground without care, the roots will be broken and bruiſed, to the great injury of the trees. When you have taken them up, the next thing is to prepare them for planting by pruning the roots and heads. And firſt as to the roots; all the ſmall fibres are to be cut off, as near to the place from whence they

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(G) It is an odd fancy that ſtale plants grow beſt, when both reaſon and experience vouch that the moſt ſucculent plants are beſt: one good plant in the centre of a large hole is ſufficient when the land is full holed.

(H) The ſtagnation of water in pools (uſual in ſtiff level lands) is the moſt injurious circumſtance attending it; for that long duration, will convert the fineſt mould into ſtiff clay. The proprietor of ſuch a ſoil muſt therefore grudge no labour to drain it well; and yet by ſuch eaſy gradation as to prevent the mould from being waſhed away by great floods, in caſe the under ſtratum be a loam.

they are produced as may be, except they are to be replanted immediately after they are taken up. Then prune off all the bruiſed or broken roots, all ſuch as are irregular and croſs each other, and all downright roots, eſpecially in fruit-trees: ſhorten the larger roots in proportion to the age, the ſtrength, and nature of the tree; obſerving that the walnut, mulberry, and ſome other tender rooted kinds ſhould not be pruned ſo cloſe as the more hardy ſorts of fruit and foreſt trees: in young fruit trees, ſuch as pears, apples, plums, peaches, &c. that are one year old from the time of their budding or grafting, the roots may be left only about eight or nine inches long; but in older trees, they muſt be left of a much greater length; but this is only to be underſtood of the larger roots: for the ſmall ones muſt be chiefly cut quite out, or pruned very ſhort. The next thing is the pruning of their heads, which muſt be differently performed in different trees; and the deſign of the trees muſt alſo be conſidered. Thus, if they are deſigned for walls or eſpaliers, it is beſt to plant them with the greateſt part of their heads, which ſhould remain on till they begin to ſhoot in the ſpring, when they muſt be cut down to five or ſix eyes, at the ſame time taking care not to diſturb the roots. But if the trees are deſigned for ſtandards, you ſhould prune off all the ſmall branches cloſe to the place where they are produced, as alſo the irregular ones which croſs each other; and after having diſplaced theſe branches, you ſhould alſo cut off all ſuch parts of branches as have by any accident been broken or wounded; but by no means cut off the main leading ſhoots which are neceſſary to attract the ſap from the root, and thereby promote the growth of the tree. Having thus prepared the trees for planting, you muſt now proceed to place them in the earth: but firſt, if the trees have been long out of the ground, ſo that the fibres of the roots are dried, place them eight or ten hours in water, before they are planted, with their heads erect and the roots only immerſed therein; which will ſwell the dried veſſels of the roots, and prepare them to imbibe nouriſhment from the earth. In planting them, great regard ſhould be had to the nature of the ſoil: for if that be cold and moiſt, the trees ſhould be planted very ſhallow; and if it be a hard rock or gravel, it will be better to raiſe a hill of earth where each tree is to be planted, than to dig into the rock or gravel, and fill it up with earth, as it is too often practiſed, by which means the trees are planted as it were in a tub, and have but little room to extend their roots. The next thing to be obſerved is, to place the trees in the hole in ſuch a manner that the roots may be about the ſame depth in the ground as before they were taken up; then break the earth fine with a ſpade, and ſcatter it into the hole, ſo that it may fall in between every root, that there may be no hollowneſs in the earth: then having filled up the hole, gently tread down the earth with your feet, but do not make it too hard; which is a great fault, eſpecially if the ground be ſtrong or wet. Having thus planted the trees, they ſhould be faſtened to ſtakes driven into the ground to prevent their being diſplaced by the wind, and ſome mulch laid upon the ſurface of the ground about their roots; as to ſuch as are planted againſt walls, their roots ſhould be placed about five or ſix inches from the wall, to which their heads ſhould be nailed to prevent their being blown up by the wind. The ſeaſons for planting are various, according to the different ſorts of trees, or the ſoil in which they are planted. For the trees whoſe leaves fall off in winter, the beſt time is the beginning of October, provided the ſoil be dry; but if it be a very wet ſoil, it is better to defer it till the latter end of February, or the beginning of March: and for many kinds of evergreens, the beginning of April is by far the beſt ſeaſon; though they may be ſafely removed at midſummer, provided they are not to be carried very far; but ſhould always make choice of a cloudy wet ſeaſon.

In the ſecond volume of the papers, &c. of the Bath Society there is a letter on planting waſte grounds. The gentleman who writes it informs us, that in the county of Norfolk, where he reſides, there were about 60 or 70 years ago vaſt tracts of uncultivated ground, which were then thought totally barren. "The weſtern parts of it (ſays he) abounded with ſand of ſo light a texture, that they were carried about by every wind; and in many places the ſands were ſo looſe that no graſs could grow upon them. Art and induſtry, however have now ſo altered the face of this once Arabian deſert, that it wears a very different appearance. Moſt of theſe tracts are either planted or rendered very good corn-land and ſheep-walks.

"About 30 years ſince, the ſides of many of our little ſand-hills were ſown with the ſeeds of French furze, and when a wet ſeaſon followed, they ſucceeded very well, and grew ſo faſt, that once in three or four years they are cut for fuel, and ſell at a good price at Thetford, Brandon, Harling, Swaffham, and places adjacent. This excited ſome public ſpirited gentlemen, among whom was the late Mr Buxton of Shadwell-Lodge, near Thetford, to attempt the planting of Scotch and ſpruce firs, and other hardy foreſt-trees. At firſt they found ſome difficulty from the extreme looſeneſs of the ſand. But as there is in all this part of the country fine white and yellow marle, at about three feet depth below the ſand, they very judiciouſly thought that incorporating it with the ſand in the holes where their young trees were planted, would inſure ſucceſs; nor were they diſappointed. The method ſucceeded beyond expectation; the plantations throve exceedingly, and the roots ſoon reached below the ſand, after which they were out of danger. This excited them to further attempts.

"On the ſpots where they intended to raiſe new plantations from ſeeds and acorns, they laid on a thick coat of marle and clay, which after being rough ſpread, and lying a winter in that ſtate, was made fine, and ploughed in juſt before planting. By theſe means the ſoil became fixed, and in a little time covered with graſs and herbage; ſo that there are now vaſt plantations of firs, oak, and foreſt-trees, in the moſt healthy and vigorous ſtate, where within my memory ten acres of land would not maintain a ſingle ſheep three months.

"But the benefit of plantations, whether of ſhrubs, copſe, or trees, is not confined to the immediate advantage, or even the future value of the wood. By anually ſhedding a great number of leaves, which the winds diſperſe, and the rains waſh into the ſoil, it is conſiderably improved; and whenever ſuch copſes have been ſtubbed up, the ground (however unfruitful before planting) has thereby been ſo enriched as to bear excellent crops for many years, without the additional help of manure. How much land-owners are intereſted in planting waſte or barren ſpots I need not mention; and nothing

thing but a degree of indolence or ignorance unpardonable in this enlightened age could induce them to neglect it.

"Nature has furniſhed us with plants, trees, and ſhrubs, adapted to almoſt every ſoil and ſituation; and as the laws of vegetation are now much better underſtood than formerly, it is a reproach to thoſe whoſe practice does not keep pace with their knowledge in making the beſt uſe of her bounty. Let no man repine and ſay *the land is barren;* for thoſe ſpots which appear to be ſo, owe that appearance to human negligence. Induſtry and art might ſoon render an eighth part of this kingdom nearly as valuable as the reſt, which now remains in a ſtate unprofitable to the owners, and diſgraceful to the community."

Reverſe Planting, a method of planting in which the natural poſition of the plant or ſhoot is inverted; the branches being ſet into the earth, and the root reared into the air. Dr Agricola mentions this monſtrous method of planting, which he found to ſucceed very well in moſt or all ſorts of fruit-trees, timber-trees, &c. Bradley affirms, that he has ſeen a lime-tree in Holland growing with its firſt roots in the air, which had ſhot out branches in great plenty, at the ſame time that its firſt branches produced roots and fed the tree. Mr Fairchild of Hoxton has practiſed the ſame with us, and gives the following directions for performing it: Make choice of a young tree of one ſhoot, of alder, elm, willow, or any other tree that eaſily takes root by laying; bend the ſhoot gently down into the earth, and ſo let it remain until it has taken root. Then dig about the firſt root, and raiſe it gently out of the ground, till the ſtem be nearly upright, and ſtake it up. Then prune the roots, now erected in the air, from the bruiſes and wounds they received in being dug up; and anoint the pruned parts with a compoſition of two ounces of turpentine, four ounces of tallow, and four ounces of bees wax, melted together, and applied pretty warm. Afterwards prune off all the buds or ſhoots that are upon the ſtem, and dreſs the wounds with the ſame compoſition, to prevent any collateral ſhootings, that might ſpoil the beauty of the ſtem,

PLANUDES, (Maximus), a Greek monk of Conſtantinople, towards the end of the 14th century, who publiſhed a collection of epigrams intitled *Anthologia*; a Greek tranſlation of Ovid's Metamorphoſes; a Life of Æſop, which is rather a romance than a hiſtory; and ſome other works, We know nothing more of him, than that he ſuffered ſome perſecution on account of his attachment to the Latin church.

PLASHING *of* Hedges, is an operation thought by ſome perſons to promote the growth and continuance of old hedges; but whether the fact be ſo or not will admit of ſome diſpute. See Hedges, n° 29, 37, &c.

It is performed in this manner: The old ſtubs muſt be cut off, &c. within two or three inches of the ground; and the beſt and longeſt of the middle-ſized ſhoots muſt be left to lay down. Some of the ſtrongeſt of theſe muſt alſo be left to anſwer the purpoſe of ſtakes. Theſe are to be cut off to the height at which the hedge is intended to be left; and they are to ſtand at ten feet diſtance one from another; when there are not proper ſhoots for theſe at the due diſtances, their places muſt be ſupplied with common ſtakes of dead wood. The hedge is to be firſt thinned, by cutting away all but thoſe ſhoots which are intended to be uſed either as ſtakes, or the other work of the plaſhing; the ditch is to be cleaned out with the ſpade; and it muſt be now dug as at firſt, with ſloping ſides each way; and when there is any cavity on the bank on which the hedge grows, or the earth has been waſhed away from the roots of the ſhrubs, it is to be made good by facing it, as they expreſs it, with the mould dug from the upper part of the ditch; all the reſt of the earth dug out of the ditch is to be laid upon the top of the bank; and the owner ſhould look carefully into it that this be done, for the workmen, to ſpare themſelves trouble, are apt to throw as much as they can upon the face of the bank; which being by this means overloaded, is ſoon waſhed off into the ditch again, and a very great part of the work undone; whereas what is laid on the top of the bank always remains there, and makes a good fence of an indifferent hedge.

In the plaſhing the quick, two extremes are to be avoided; theſe are, the laying it too low, and the laying it too thick. The latter makes the ſap run all into the ſhoots, and leaves the plaſhes without ſufficient nouriſhment; which, with the thickneſs of the hedge, finally kills them. The other extreme of laying them too high, is equally to be avoided; for this carries up all the nouriſhment into the plaſhes, and ſo makes the ſhoots ſmall and weak at the bottom, and conſequently the hedge thin. This is a common error in the north of England. The beſt hedges made any where in England are thoſe in Hertfordſhire; for they are plaſhed in a middle way between the two extremes, and the cattle are by that prevented both from cropping the young ſhoots, and from going through; and a new and vigorous hedge ſoon forms itſelf.

When the ſhoot is bent down that is intended to be plaſhed, it muſt be cut half way through with the bill: the cut muſt be given ſloping, ſomewhat downwards, and then it is to be wound about the ſtakes, and after this its ſuperfluous branches are to be cut off as they ſtand out at the ſides of the hedge. If for the firſt year or two, the field where a new hedge is made can be ploughed, it will thrive the better for it; but if the ſtubs are very old, it is beſt to cut them quite down, and to ſecure them with good dead hedges on both ſides, till the ſhoots are grown up from them ſtrong enough to plaſh; and wherever void ſpaces are ſeen, new ſets are to be planted to fill them up. A new hedge raiſed from ſets in the common way, generally requires plaſhing in about eight or nine years after.

PLASSEY, is a grove near the city of Muxadab in India, famous for a battle fought between the Engliſh under Lord Clive and the native Hindoos under the Nabob Surajah Dowlah. The Britiſh army conſiſted of about 3200 men, of whom the Europeans did not exceed 900; while that of the Nabob conſiſted of 50,000 foot, and 18,000 horſe. Notwithſtanding this great diſproportion, however, Lord Clive effectually routed the Nabob and his forces, with the loſs of 3 Europeans and 26 Seapoys killed, and 5 Europeans and 40 Seapoys wounded. The Nabob's loſs was eſtimated at about 200 men, beſides oxen and elephants. See Clive.

PLASTER, or Emplaster, in pharmacy, an external application of a harder conſiſtence than an ointment to be ſpread, according to the different circumſtances of the wound, place, or patient, either upon linen or leather. See PHARMACY, n° 613—635.

PLASTER, or *Plaiſter*, in building, a compoſition of lime, ſometimes with ſand, &c. to parget, or cover the nudities of a building. See PARGETING and STUCCO.

PLASTER *of Paris*, a preparation of ſeveral ſpecies of gypſum dug near Mount Maitre, a village in the neighbourhood of Paris; whence the name. See ALABASTER, GYPSUM, and CHEMISTRY, n° 635, &c.

The beſt ſort is hard, white, ſhining, and marbly; known by the name of *plaſter-ſtone* or *parget of Mount Maitre*. It will neither give fire with ſteel, nor ferment with aquafortis; but very freely and readily calcines in the fire into a fine plaſter, the uſe of which in building and caſting ſtatues is well known.

The method of repreſenting a face truly in plaſter of Paris is this: The perſon whoſe figure is deſigned is laid on his back, with any convenient thing to keep off the hair. Into each noſtril is conveyed a conical piece of ſtiff paper, open at both ends, to allow of reſpiration. Theſe tubes being anointed with oil, are ſupported by the hand of an aſſiſtant; then the face is lightly oiled over, and the eyes being kept ſhut, alabaſter freſh calcined, and tempered to a thiniſh conſiſtence with water, is by ſpoonfuls nimbly thrown all over the face, till it lies near the thickneſs of an inch. This matter grows ſenſibly hot, and in about a quarter of an hour hardens into a kind of ſtony concretion; which being gently taken off, repreſents, on its concave ſurface, the minuteſt part of the original face. In this a head of good clay may be moulded, and therein the eyes are to be opened, and other neceſſary amendments made. This ſecond face being anointed with oil, a ſecond mould of calcined alabaſter is made, conſiſting of two parts joined lengthwiſe along the ridge of the noſe: and herein may be caſt, with the ſame matter, a face extremely like the original.

If finely powdered alabaſter, or plaſter of Paris, be put into a baſon over a fire, it will, when hot, aſſume the appearance of a fluid, by rolling in waves, yielding to the touch, ſteaming, &c. all which properties it again loſes on the departure of the heat; and being thrown upon paper, will not at all wet it, but immediately diſcover itſelf to be as motionleſs as before it was ſet over the fire; whereby it appears, that a heap of ſuch little bodies, as are neither ſpherical nor otherwiſe regularly ſhaped, nor ſmall enough to be below the diſcernment of the eye, may, without fuſion, be made fluid, barely by a ſufficiently ſtrong and various agitation of the particles which compoſe it; and moreover loſe its fluidity immediately upon the ceſſation thereof.

Two or three ſpoonfuls of burnt alabaſter, mixed up thin with water, in a ſhort time coagulates, at the bottom of a veſſel full of water, into a hard lump, notwithſtanding the water that ſurrounds it. Artificers obſerve, that the coagulating property of burnt alabaſter will be very much impaired or loſt, if the powder be kept too long, eſpecially if in the open air, before it is made uſe of; and when it hath been once tempered with water, and ſuffered to grow hard, they cannot, by any burning or powdering of it again, make it serviceable for their purpoſes as before.

This matter, when wrought into veſſels, &c. is ſtill of ſo looſe and ſpongy a texture, that the air has eaſy paſſage through it. Mr Boyle gives an account, among his experiments with the air-pump, of his preparing a tube of this plaſter, cloſed at one end and open at the other; and on applying the open end to the cement, as is uſually done with the receivers, it was found utterly impoſſible to exhauſt all the air out of it; for freſh air from without preſſed in as faſt as the other, or internal air, was exhauſted, though the ſides of the tube were of a conſiderable thickneſs. A tube of iron was then put on the engine; ſo that being filled with water, the tube of plaſter of Paris was covered with it; and on uſing the pump, it was immediately ſeen, that the water paſſed through into it as eaſily as the air had done, when that was the ambient fluid. After this, trying it with Venice turpentine inſtead of water, the thing ſucceeded very well; and the tube might be perfectly exhauſted, and would remain in that ſtate ſeveral hours. After this, on pouring ſome hot oil upon the turpentine, the caſe was much altered; for the turpentine melting with this, that became a thinner fluid, and in this ſtate capable of paſſing like water into the pores of the plaſter. On taking away the tube after this, it was remarkable that the turpentine, which had pervaded and filled its pores, rendered it tranſparent, in the manner that water gives tranſparency to that ſingular ſtone called *oculus mundi*. In this manner, the weight of air, under proper management, will be capable of making ſeveral ſorts of glues penetrate plaſter of Paris: and not only this, but baked earth, wood, and all other bodies, porous enough to admit water on this occaſion.

Plaſter of Paris is uſed as a manure in Pennſylvania: a letter from a gentleman in this country inſerted in the 5th volume of the Bath Society Papers, repreſents its utility and which we ſhall inſert here for the ſatisfaction and information of our agricultural readers. "The beſt kind is imported from hills in the vicinity of Paris: it is brought down the Seine, and exported from Havre de Grace. I am informed there are large beds of it in the Bay of Fundy, ſome of which I have ſeen nearly as good as that from France; nevertheleſs ſeveral cargoes brought from thence to Philadelphia have been uſed without effect. It is probable this was taken from the top of the ground, and by the influenſe of the ſun and atmoſphere diſpoſſeſſed of the qualities neceſſary for the purpoſes of vegetation. The lumps compoſed of flat ſhining ſpecula are preferred to thoſe which are formed of round particles like ſand: the ſimple method of finding out the quality is to pulverize ſome, and put it dry into an iron pot over the fire, when that which is good will ſoon boil, and great quantities of the fixed air eſcape by ebullition. It is pulveriſed by firſt putting it in a ſtamping-mill. The finer its pulverization the better, as it will thereby be more generally diffuſed.

"It is beſt to ſow it in a wet day. The moſt approved quantity for graſs is ſix buſhels per acre. No art is required in ſowing it more than making the diſtribution as equal as poſſible on the ſward of graſs. It operates altogether as a top manure, and therefore ſhould not be put on in the ſpring until the principal froſts are over and vegetation hath begun. The general time for ſowing with us is in April, May, June, July, Auguſt, and even as late as September. Its effects will generally appear in 10 or 15 days; after which the growth of the graſs will be ſo great as to produce a large burden at the end of ſix weeks after ſowing.

"It muſt be ſown on dry land, not ſubject to be overflown. I have ſown it on ſand, loam, and clay, and it is difficult to ſay on which it has beſt anſwered, although the effect is ſooner viſible on ſand. It has been uſed as a manure in this ſtate for upwards of twelve years. Its duration may, from the beſt information I can collect, be eſtimated from ſeven to twelve years; for, like other manure, its continuance very much depends on the nature of the ſoil on which it is placed.

"One of my neighbours ſowed ſome of his graſs ground ſix years ago, another four years ago; a great part of my own farm was ſown in May 1788. We regularly mow two crops, and paſture in autumn; no appearance of failure, the preſent crop being full as good as any preceding. I have this ſeaſon mowed fifty acres of red clover, timothy-graſs, white clover, &c. which was plaſtered laſt May, July, and September: many who ſaw the graſs eſtimated the produce at two tons per acre, but I calculate the two crops at three tons. Several ſtripes were left in the different fields without plaſter; theſe were in a meaſure unproductive, being ſcarce worth mowing. In April 1788, I covered a piece of graſs land upwards of two inches thick with barn manure; in the ſame worn-out field I ſowed plaſter, to contraſt it with the dung. I mowed the dunged and plaſtered land twice laſt year and once this; in every crop the plaſter has produced the moſt. You will remember, in all experiments with clover, to mix about one-third timothy graſs ſeed; it is of great advantage in ſerving as a ſupport for the clover; it very much facilitates the curing of clover, and when cured is a ſuperior fodder. The plaſter operates equally as well on the other graſſes as on clover. Its effect is ſaid to be good on wheat, if ſown in the ſpring; but I cannot ſay this from experience. On Indian corn I know its operation to be great; we uſe it at the rate of a table-ſpoonful for a hill, put in immediately after dreſſing.

"From ſome accurate experiments laſt year made and reported to our Agricultural Society, it appears that nine buſhels of additional corn per acre were produced by this method of uſing plaſter."

PLASTERING. See Pargetting.

PLASTIC, denotes a thing endowed with a formative power, or a faculty of forming or faſhioning a maſs of matter after the likeneſs of a living being.

Plaſtic-Nature, a certain power by which, as an inſtrument, many philoſophers, both ancient and modern, have ſuppoſed the great motions in the corporeal world, and the various proceſſes of generation and corruption, to be perpetually carried on.

Among the philoſophers of Greece, ſuch a power was almoſt univerſally admitted. It ſeems, indeed, to have been rejected only by the followers of Democritus and Epicurus, who talk as if they had thought gravity eſſential to matter, and the *fortuitous* motion of atoms, which they held to have been from eternity, the ſource not only of all the *regular* motions in the univerſe, but alſo of the *organization* of all corporeal ſyſtems, and even of *ſenſation* and *intellection*, in brutes and in men. It is needleſs to ſay, that thoſe men, whatever they might profeſs, were in reality atheiſts; and Democritus, it is univerſally known, avowed his atheiſm.

The greater part of the philoſophers who held the exiſtence of a plaſtic nature, conſidered it not as an *agent* in the ſtrict ſenſe of the word, but merely as an inſtrument in the hand of the Deity; though even among them there were ſome who held no ſuperior power, and were of courſe as groſs atheiſts as Democritus himſelf. Such was *Strato* of Lampſacus. This man was originally of the peripatetic ſchool, over which he preſided many years, with no ſmall degree of reputation for learning and eloquence. He was the firſt and chief aſſertor of what has been termed *Hylozoic atheiſm*; a ſyſtem which admits of no power ſuperior to a certain *natural* or *plaſtic life*, *eſſential*, *ingenerable*, and *incorruptible*, inherent in matter, but without ſenſe and conſciouſneſs. That ſuch was his doctrine we learn from Cicero, who makes *Velleius* the Epicurean ſay, "Nec audiendus *Strato* qui *Phyſicus* appellatur, qui omnem vim divinam in Natura ſitam eſſe cenſet, quæ cauſas gignendi, augendi, minuendive habeat, ſed careat omni ſenſu ‡." That Strato, in admitting this plaſtic principle, differed widely from Democritus, is apparent from the following account of him by the ſame author: "*Strato Lampſacenus* negat opera deorum ſe uti ad fabricandum mundum, quæcunque ſint docet omnia eſſe effecta *naturæ*, nec ut ille, qui aſperis, et levibus, et hamatis uncinatiſque corporibus concreta hæc eſſe dicat, interjecto inani; ſomnia cenſet hæc eſſe *Democriti*, non docentis ſed optantis §."

That the rough and ſmooth, and hooked and crooked, atoms of Democritus, were indeed dreams and dotages, is a poſition which no man will controvert; but ſurely Strato was himſelf as great a dreamer when he made ſenſation and intelligence reſult from a certain plaſtic or ſpermatic life in matter, which is itſelf devoid of ſenſe and conſciouſneſs. It is, indeed, inconceivable, to uſe the emphatic language of Cudworth, "how any one in his ſenſes ſhould admit ſuch a monſtrous paradox as this, that every atom of duſt has in itſelf as much wiſdom as the greateſt politician and moſt profound philoſopher, and yet is neither conſcious nor intelligent!" It is to be obſerved of Strato likewiſe, that though he attributed a certain kind of life to matter, he by no means allowed of one common life as ruling over the whole material univerſe. He ſuppoſed the ſeveral parts of matter to have ſo many ſeveral plaſtic lives of their own, and ſeems ‡ to have attributed ſomething to chance in the production and preſervation of the mundane ſyſtem.

In denying the exiſtence of a God, perpetually directing his plaſtic principle, and in ſuppoſing as many of theſe principles as there are atoms of matter, Strato deviated far from the doctrine of Ariſtotle. The great founder of the peripatetic ſchool, as well as his apoſtate diſciple, taught that mundane things are not effected by fortuitous mechaniſm, but by ſuch a *nature* as acts regularly and artificially for *ends*; yet he never conſiders this *nature* as the higheſt principle, or ſupreme *Numen*, but as ſubordinate to a perfect mind or intellect; and he expreſsly affirms, that "*mind*, together with *nature*, formed or faſhioned this univerſe." He evidently conſiders mind as the principal and intelligent agent, and nature as the ſubſervient and executive inſtrument. Indeed, we are ſtrongly inclined to adopt the opinion of the learned Moſheim, who thinks that by nature Ariſtotle meant nothing more than that θερμοτης ψυχικην, or *animal heat*, to which he attributes immortality, and of which he expreſsly ſays ‡ that all things are full. Be

‡ De Naturæ Deorum, lib. i. cap. 13.

§ Acad. Queſt. lib. iv. cap. 38.

‡ Cud. Int. Syſt. ed. Moſheim, lib. i. cap. 3.

‡ De Generatione Animal. lib. iii. cap. 11.

this as it may, he always joins God and nature together, and affirms that they do nothing in vain. The ſame doctrine was taught before him by Plato, who affirms that "nature, together with reaſon, and according to it, orders all things." It muſt not, however, be concealed, that Plato ſeems to have attributed intelligence to the principle by which he ſuppoſed the world to be animated; for Chalcidius, commenting on the Timæus‡, thus expreſſes himſelf: "Hæc eſt illa *rationabilis* anima mundi, quæ gemina juxta meliorem naturam veneratione tutelam præbet inferioribus, divinis diſpoſitionibus obſequens, providentiam nativis impertiens, æternorum ſimilitudine propter cognationem beata."—Apuleius, too, tells us||, "Illam cœleſtem animam, fontem animarum omnium, optimam virtutem eſſe genetricem, ſubſerviri etiam Fabricatori Deo, et præſto eſſe ad omnia inventa ejus." *Plato pronounciat.*

‡ ſect 53.

|| De Dogmate Platonis.

This doctrine of Plato has been adopted by many moderns of great eminence both for genius and for learning. The celebrated Berkeley biſhop of Cloyne, after giving the view of Plato's *anima mundi*, which the reader will find in our article Motion, n° 10, thus recommends the ſtudy of this philoſophy*: "If that philoſopher himſelf was not read only, but ſtudied alſo with care, and made his own interpreter, I believe the prejudice that now lies againſt him ſhould ſoon wear off, or be even converted into high eſteem, for thoſe exalted notions, and fine hints, that ſparkle and ſhine throughout his writings; which ſeem to contain not only the moſt valuable learning of Athens and Greece, but alſo a treaſure of the moſt remote traditions and early ſcience of the eaſt." Cudworth, and the learned author of *Ancient Metaphyſics*, are likewiſe ſtrenuous advocates for the Ariſtotelian doctrine of a plaſtic nature diffuſed through the material world; (ſee Metaphysics, n° 200, 201, 202.): and a notion very ſimilar has lately occurred to a writer who does not appear to have borrowed it either from the *Lyceum* or the *Academy*.

* Siris, n° 338.

This writer is Mr Young, of whoſe *active ſubſtance*, and its agency in moving bodies, ſome account has been given elſewhere, (ſee Motion). As a mere unconſcious agent, *immaterial*, and, as he expreſſes himſelf, *immental*, it bears a ſtriking reſemblance to the *plaſtic nature* or *vegetable life* of Cudworth: but the author holds it to be not only the principle of motion, but alſo the *baſis* or *ſubſtratum* of matter itſelf; in the production of which, by certain motions, it may be ſaid to be more ſtrictly *plaſtic* than the *hylarchical* principle, or *vis genitrix*, of any other philoſopher with whoſe writings we have any acquaintance. Though this opinion be ſingular, yet as its author is evidently a man who thinks for himſelf, unawed by the authority of celebrated names, and as one great part of the utility of ſuch works as ours conſiſts in their ſerving as indexes to ſcience and literature, we ſhall lay before our readers a ſhort abſtract of the reaſonings by which Mr Young endeavours to ſupport his hypotheſis, and we ſhall take the liberty of remarking upon thoſe reaſonings as we proceed.

The author, after a ſhort introduction, enters upon his work‡, in a chapter entitled, *Analyſis of Matter in general*. In that chapter there is little novelty. He treats, as others have done, of primary and ſecondary qualities, and adheres too cloſely to the language of Locke, when he ſays, that "the nature of bodies ſignifies the aggregate of all thoſe *ideas* with which they furniſh us, and by which they are made known." To ſay the beſt of it, this ſentence is inaccurately expreſſed. An aggregate of *ideas* may be occaſioned by the impulſe of bodies on the organs of ſenſe, but the effect of impulſe cannot be that which impels. We ſhould not have made this remark, which may perhaps be deemed captious, were we not purſuaded that the vague and inaccurate uſe of terms is the ſource of thoſe miſtakes into which, we cannot help thinking, that the very ingenious author has ſometimes fallen. Having juſtly obſerved, that we know nothing directly of bodies but their qualities, he proceeds to inveſtigate the nature of ſolidity,

‡ An Eſſay on the powers and mechaniſm of nature.

"Solidity (he ſays) is the quality of body which principally requires our notice. It is that which fills extenſion, and which reſiſts other ſolids, occupying the place which it occupies; thus making extenſion and figure real, and different from mere ſpace and vacuity. If the ſecondary qualities of bodies, or their powers, variouſly to affect our ſenſes, depend on their primary qualities, it is chiefly on this of ſolidity; which is therefore the moſt important of the primary qualities, and that in which the eſſence of body is by ſome conceived to conſiſt. This idea of ſolidity has been judged to be incapable of any analyſis; but it appears evident to me (continues our author), that the idea of ſolidity may be reſolved into another idea, which is that of the power of reſiſting within the extenſion of body. Hence it becomes unneceſſary, and even inadmiſſible, to ſuppoſe that ſolidity in the body is at all a pattern or archetype of our ſenſation."

That ſolidity in the body, and we know nothing of ſolidity any where elſe, is no pattern of any ſenſation of ours, is indeed moſt true, as we have ſhown at large in another place, (ſee Metaphysics, n° 44 and 171): but to reconcile this with what our author aſſerts immediately afterwards, that "ſolidity is no more in bodies than colours and flavours are, and that it is equally with them a *ſenſation* and an *idea*," would be a taſk to which our ingenuity is by no means equal. He affirms, indeed, that ſolidity, as it is ſaid to be in bodies, is utterly incomprehenſible; that we can perfectly comprehend it as a ſenſation in ourſelves, but that in bodies nothing more is required than a power of active reſiſtance to make upon our ſenſes thoſe impreſſions from which we infer the reality of primary and ſecondary qualities. This power of reſiſtance, whether it ought to be called active or paſſive, we apprehend to be that which all other philoſophers have meant by the word *ſolidity*; and though Locke, who uſes the words *idea* and *notion* indiſcriminately, often talks of the *idea* of ſolidity, we believe our author to be the firſt of human beings who has thought of treating *ſolidity* as a ſenſation in the mind.

Though it is wrong to innovate in language, when writing on ſubjects which require much attention, we muſt, however, acknowledge it to be unworthy of inquirers after truth to diſpute about the proper or improper uſe of terms, ſo long as the meaning of him who employs them can be eaſily diſcovered. We ſhall, therefore, follow our author in his endeavours to aſcertain what this power of reſiſtance is which is commonly known by the name of ſolidity. All power he juſtly holds to be active; and having, by an argument (A) of which we do

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"(A) we can only conceive of ſolidity as being a reſiſtance of the *parts* of any body, to a power which endeanot perceive the force, attempted to prove that it is by an inward *power*, and not by its *inertia*, that one body prevents another from occupying the ſame place with itſelf, he naturally enough infers matter to be eſſentially active. "But the activity of matter is to be conſidered in a certain limited ſenſe, and its inertneſs is to be regarded in another limited ſenſe; ſo that theſe are compatible within their reſpective limits. The activity of body may be conſidered as belonging to the parts of a compound; its inertia as the inertia formed of thoſe parts. The actions of the parts are everywhere oppoſed to each other, and equal; and hence reſults the inactivity of the whole."

SOLIDITY alone of the primary qualities being poſitive, and peculiar to bodies, and our author having reſolved this into ACTION OR POWER, it follows, by his analyſis, that the ESSENCE OF BODY is reduced to power likewiſe. But, as he properly obſerves, power is an idea of reflection, not acquired by the ſenſes, but ſuggeſted by thought. Hence our knowledge of real exiſtence in body muſt be ſuch as is ſuggeſted to us by our thoughts exerciſed about our ſenſations. "We are capable of acting and producing changes in appearances; and this faculty, which we experience to exiſt in ourſelves, we call power. We are conſcious of the exertion of our own power; and therefore, when we ſee ACTION OR CHANGE happen without any exertion of ours, we refer this to other powers without us, and neceſſarily conclude the POWER to exiſt where the change begins or the action is exerted. This power, then, referred to bodies, muſt exiſt in them, or it can exiſt no where."

In two chapters, which might eaſily have been compreſſed into one not ſo long as the ſhorteſt of them, our author analyzes *atoms* or the primary particles of matter, and ſtrenuouſly oppoſes their impenetrability. He allows that there are atoms of matter not diviſible by any known force; but as theſe, however ſmall, muſt ſtill be conceived as having extenſion, each of them muſt be compoſed of parts held together by the ſame power which binds together many atoms in the ſame body. This power, indeed, he acknowledges to operate much more forcibly when it cements the parts of a primary atom than when it makes many atoms cohere in one maſs; but ſtill it operates in the ſame manner: and as the ideal analyſis may be carried on *ad infinitum*, the only poſitive idea which is ſuggeſted by atoms, or the parts of atoms, is the idea of a reſiſting power. That this power of reſiſtance, which conſtitutes what is vulgarly called the ſolidity of bodies, may not be abſolutely impenetrable, he attempts to prove, by ſhowing that reſiſtance does in fact take place in caſes where impenetrability, and even ſolidity, are not ſuppoſed by any man.

"Let us endeavour (ſays he) to bring together two like poles of a magnet, and we ſhall experience a reſiſtance to their approximation. Why, then, may not a piece of iron, which between our fingers reſiſts their coming together, reſiſt by an efficacy perfectly ſimilar, tho' more ſtrongly exerted? If magnetiſm were to act upon our bodies as upon iron, we ſhould feel it; or were magnets endowed with ſenſation, they would feel that which reſiſts their nearer approach. The reſiſting extenſion between the two magnets is permeable to all the rays of light, and reflecting none is therefore unſeen; but it is eaſy to conceive that the ſame power which reſiſts the approach of the iron might reſiſt and reflect ſome rays of light. We ſhould then have a viſible object interpoſed between the two magnets, as we have before ſuppoſed it might be a tangible one. It is likewiſe eaſy to conceive that which is tangible and viſible ſo applied to our organs of taſting, of ſmelling, and of hearing, as to excite ideas of flavours, odours, and ſounds. Thus we ſee that an action, in which no ſuppoſition of ſolidity or impenetrability is involved, may be conceived to aſſume all the qualities of matter, by only ſuppoſing a familiar effect extended in its operation."

This reaſoning is exceedingly ingenious, though perhaps not original; but what is of more importance, it does not approach ſo near to demonſtration as the author ſeems to imagine. If magnets operate by means of a fluid iſſuing from them (ſee MAGNETISM, chap. 3.), thoſe who hold the ſolidity or impenetrability of matter will maintain, that each atom of the magnetic fluid is ſolid and impenetrable. That we do not ſee nor feel theſe atoms, will be conſidered as no argument that they do not exiſt; for we do not ſee, nor in a cloſe room feel, the atoms of the ſurrounding atmoſphere; which yet Mr Young will acknowledge to have a real exiſtence, and to be capable of operating upon our ſenſes of hearing and ſmelling. Let us, however, ſuppoſe, that by this reaſoning

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vours to *ſeparate* them, or to bring them *nearer* together. Now, that which reſiſts any power, and prevents its effect, is alſo a power. By reſiſtance, I mean here an active reſiſtance, ſuch as an animal can employ againſt an animal. If a horſe pulls againſt a load, he draws it along; but if he draws againſt another horſe, he is put to a ſtand, and his endeavour is defeated. When any endeavour to change the ſituation of the parts of any ſolid is in like manner prevented from taking effect, and the parts retain their ſituation, the ſituation has plainly been preſerved by an active reſiſtance or power, equivalent to that which was fruitleſsly exerted on them."

Such is our author's reaſoning to prove that matter is eſſentially active, and that from this activity reſults our notion of its ſolidity: but does he not here confound ſolidity with hardneſs, and impenetrability with coheſion? He certainly does; for *water* is as *ſolid*, in the proper ſenſe of the word, as *adamant*, and the particles of *air* as the particles of *iron*. The parts of water are, indeed, ſeparated with eaſe, and thoſe of adamant with difficulty; but it is not becauſe the latter have more ſolidity than the former, but becauſe the power of coheſion, whatever it may be, operates upon them with greater force. Solidity is an attribute of a whole; hardneſs and ſoftneſs reſults from the coheſion of parts. We do not at all perceive the propriety of the ſimile of the horſe pulling a load, and afterwards pulling againſt another horſe. Is it becauſe both horſes are *active* that one of them cannot prevail againſt the other, and becauſe the load is *inactive* that either of them may drag along a maſs of iron of half a tun weight? If ſo, double or triple the maſs, and a very ſtrange phenomenon will be the reſult; for we ſhall have an active whole compounded of two or three inactive parts, even though thoſe parts ſhould not be in contact!

reaſoning he has eſtabliſhed the non-exiſtence of every thing in the primary atoms of matter but active powers of reſiſtance, and let us ſee how he conceives the actions of theſe powers to conſtitute what gives us the notion of inert and ſolid body; for that we have ſuch a notion cannot be denied.

To ACT he allows to be an attribute, and juſtly obſerves, that we cannot conceive an attribute to exiſt without a ſubſtance. "But (ſays he) we have traced all phenomena to action as to a generic idea, comprehending under it all forms of matter and motion as ſpecies of that genus. By this analyſis, that complex idea we have uſually denominated matter, and conſidered as the ſubſtance or ſubſtratum to which motion appertained as an attribute, is found to change its character, and to be itſelf an attribute of a ſubſtance eſſentially active, of which one modification of motion produces matter and another generates motion." The action of this ſubſtance Mr Young determines to be motion (ſee MOTION, n° 16.); and he proceeds to inquire by what kind of motion it produces matter, or inert and reſiſting atoms.

"Whatever portion of the ACTIVE SUBSTANCE is given to form an atom, the following things are neceſſary to be united in ſuch portion of active ſubſtance: *1ſt*, It muſt in ſome reſpect continually move; for otherwiſe it would loſe its nature, and ceaſe to be active. *2dly*, It muſt alſo in ſome other reſpect be at reſt, for otherwiſe it would not form an active atom. *3dly*, It muſt preſerve unity within itſelf." The author's proof of the firſt of theſe poſitions we have given elſewhere. The ſecond he holds to be ſelf-evident; and the third he thinks eſtabliſhed by the following reaſoning: "Solidity is the reſult of thoſe actions among the parts of any whole, whereby the unity of the whole is preſerved within itſelf. Several uncohering things may be united by an external bond: this does not conſtitute theſe one ſolid; it may be one bundle: but if ſeveral things cohere, and have a unity preſerved within themſelves, they become one ſolid. An atom is the leaſt and moſt ſimple ſolid."

Having thus proved the neceſſity of theſe three requiſites to the formation of an atom, he obſerves, that "the two firſt can only be united in a rotation of the portion of active ſubſtance about a center or axis at reſt. By ſuch a motion, *all the parts* ſucceſſively occupy *different places* in the orbit of rotation, and therefore move; the centre round which they revolve being at reſt, the *whole portion* is alſo at reſt; and thus the portion is at once moving and quieſcent, as is required. The ſame kind of motion will alſo fulfil the terms of the third requſite; for a ſubſtance having a revolving motion around its own centre, preſerves its unity by reaſon of all the parts preſerving the ſame relation to the centre: and further, a motion of the active ſubſtance about a centre or axis will be an activity in the ſame orbit, which will act upon and reſiſt whatever ſhall interfere to oppoſe its activity, or deſtroy the unity of the ſphere, by diverting the courſe of the revolving motions. The activity or motion of a portion of ACTIVE SUBSTANCE about a centre will, therefore, give ſolidity to ſuch portion; for it will give it unity and reſiſtance, and in a manner tie together all the parts, forming them into one maſs about their common centre: for they move or are active not *towards* the centre, in which caſe they would be loſt in non-extenſion; nor *from* the centre, where they would diſſipate in boundleſs ſpace; but *about* the centre, preſerving the ſame limits of extenſion: and being in this way active, they in this way reſiſt any other activity oppoſed to them, that is, they reſiſt any action which tends to penetrate or divide this ſphere of revolving activity. Therefore, ſince any portion of active ſubſtance does, by revolving about a centre, become an united, reſiſting, and quieſcent whole, the ſmalleſt portions of the ACTIVE SUBSTANCE which have ſuch motions will become *atoms*, or make the ſmalleſt portions of matter."

Having thus ſhown to his own ſatisfaction how atoms of matter are formed, he next explains what at firſt he confeſſes may have appeared a paradox, "how the ACTIVE SUBSTANCE, retaining its own nature and eſſential properties, continuing immaterial, unſolid, and active, puts on at the ſame time the form of matter, and becomes material, ſolid, and inert. A ſphere of revolving active ſubſtance, as it revolves continually about a centre, and as parts of the ſubſtance, are conſidered as ſucceſſively paſſing through every point in the orbit; conſidered thus in its parts, and in its motions, it is ACTIVE SUBSTANCE, immaterial, and unſolid; but the whole ſphere, conſidered unitically, collectively, and as quieſcent, is in this point of view a ſolid atom, material, and inert."

Such is the active ſubſtance of Mr Young, and ſuch his theory of the formation of matter. That he has not with ſervility copied from the ancients, every reader of his book, who is not an abſolute ſtranger to Greek and Roman literature, will readily acknowledge; and yet if his theory be well founded, he has diſcovered a middle ſubſtance between mind and matter, more properly *plaſtic* than Ariſtotle or Plato, Cudworth or Berkeley, ever conceived. But truth compels us to add, that to us his theory appears to labour under inſuperable objections, That there *may* be in the univerſe a ſubſtance eſſentially active, and at the ſame time not intelligent, is a propoſition which we are by no means inclined to controvert. Various phenomena, both in vegetable and animal life, lead us to ſuſpect that there is ſuch a ſubſtance; but it does not follow that we are inclined to adopt our author's doctrine reſpecting the formation of matter. He conceives his proof, indeed, to be "in its nature not at all imperfect, or to fall ſhort of demonſtration; and if any one refuſe it, he thinks it will be neceſſary for him to ſhow, either that the explanation offered is not ſufficient, or that ſome other explanation will ſerve equally well."

To ſhow that the explanation offered is not ſufficient, will not, we apprehend, be a very arduous taſk; but we have no inclination to attempt ourſelves another explanation, becauſe we believe that of the formation of matter no other account can be given than that which reſolves it into the *fiat* of the Creator. That it cannot be formed by the motion of an immaterial ſubſtance in the manner which our author has very clearly deſcribed, ſeems to be a truth ſo evident as not to admit of proof; for if motion be, as he defines it, a change of place, every thing that is moved muſt have the quality of extenſion. But all the parts of this active ſubſtance which are given to form an atom, move round a centre, and are expreſsly ſaid to occupy ſucceſſively different *places* in the orbit of rotation. Every one of theſe parts, therefore, is an extended being: and ſince, according to our author, ſolidity is nothing but an *active power of reſiſtance*, and the parts of this active ſubſtance, in their rotation round their centre, *act upon* and *reſiſt* whatever interferes to oppoſe their activity, it follows that each of theſe parts is likewiſe a *ſolid being*. But, in the opinion of Mr Young himſelf, and of all mankind, whatever is extended and ſolid is material. This theory, therefore, exhibits a proceſs in which atoms are formed of a ſubſtance, which, though it is ſaid to be *active*, *immaterial*, and unſolid, appears, when narrowly inſpected, to be nothing elſe than a collection of thoſe very atoms of which the author pretends to explain the formation. Mr Young, who examines and very freely cenſures ſome of the doctrines of Newton and others, is too much a man of ſcience to be offended at us for ſtating objections to a theory which is quite new, to a transformation which he himſelf acknowledges may to many "appear not only problematical and difficult to conceive, but wholly impoſſible, and implying contradictions abſolutely and for ever irreconcileable." Whether this be a juſt character of it our readers muſt determine; but if we did not believe the author to be a man of ingenuity, we ſhould not have introduced him or his work to their acquaintance.

Plaſtic Art, the art of repreſenting all ſorts of figures by the means of moulds. This term is derived from the Greek word πλαϛικη, which ſignifies the "art of forming, modelling, or caſting, in a mould." A mould in general is a body that is made hollow for that purpoſe. The artiſt makes uſe of them to form figures in bronze, lead, gold, ſilver, or any other metal or fuſible ſubſtance. The mould is made of clay, ſtucco, or other compoſition, and is hollowed into the form of the figure that is to be produced; they then apply the jet, which is a ſort of funnel, through which the metal is poured that is to form the figures, and that is called *running the metal into the mould*.

It is in this manner, but with much practice and attention, that the artiſt forms, 1. Equeſtrian and pedeſtrian ſtatues of every kind; 2. Groups; 3. Pedeſtals; 4. Baſs reliefs; 5. Medallions; 6. Cannons, mortars, and other pieces of artillery; 7. Ornaments of architecture, as capitals, baſes, &c.; 8 Various ſorts of furniture, as luſtres, branches, &c. in every kind of metal: and in the ſame manner figures are caſt in ſtucco, plaſter, or any other fuſible matter. See *Plaster of Paris*.

Wax being a ſubſtance that is very eaſily put in fuſion, plaſtic makes much uſe of it. There are impreſſions which are highly pleaſing in coloured wax, of medallions, baſſo and alto relievos, and of detached figures; which, however, are ſomewhat brittle. But this matter has been carried too far: they have not only formed moulds to repreſent the likeneſs and the buſt of a living perſon, by applying the plaſter to the face itſelf, and afterwards caſting melted wax into the mould: but they have alſo painted that waxen buſt with the natural colours of the face, and have then applied glaſs eyes and natural hair; to which they have joined a ſtuffed body and limbs, with hands of wax; and have, laſtly, dreſſed their figure in a real habit; and by theſe means have produced an object the moſt ſhocking and deteſtable that it is poſſible to conceive. It is not a ſtatue, a buſt, a natural reſemblance that they form; but a dead body, a lifeleſs countenance, a mere carcaſe. The ſtiff air, the inflexible muſcles, the haggard eyes of glaſs, all contribute to produce an object that is hideous and diſguſtful to every man of taſte. Figures like theſe offend by affording too exact an imitation of nature. In no one of the polite arts ought imitation ever to approach ſo near the truth as to be taken for nature herſelf. Illuſion muſt have its bounds; without which it becomes ridiculous.

There is another invention far more ingenious and pleaſing, which is that wherein M. Lippart, antiquary and artiſt at Dreſden, has ſo much excelled. He has found the means of reſembling, by indefatigable labour, great expence, and infinite taſte, that immenſe number of ſtones, engraved and in camaieu, which are to be ſeen in the moſt celebrated cabinets. He has made choice of thoſe that are the moſt beautiful; and, with a paſte of his own invention, he takes from theſe ſtones an impreſſion that is ſurpriſingly accurate, and which afterwards become as marble: theſe impreſſions he calls *paſti*. He then gives them a proper colour, and incloſes each with a gold rim; and, by ranging them in a judicious order forms of them an admirable ſyſtem. They are fixed on paſteboards, which form ſo many drawers, and are then incloſed in caſes, which repreſent folio volumes, and have titles wrote on their backs; ſo that theſe fictitious books may conveniently occupy a place in a library. Nothing can be more ingenious than this invention; and, by means of it, perſons of moderate fortune are enabled to make a complete collection of all antiquity has left that is excellent of this kind; and the copies are very little inferior to the originals.

There is alſo another method of taking the impreſſions of camaieus, medals, and coins, which is as follows: They waſh or properly clean the piece whoſe impreſſion is to be taken, and ſurround it with a border of wax. They then diſſolve iſinglaſs in water, and make a decoction of it, mixing with it ſome vermilion, to give it an agreeable red colour. They pour this paſte, when hot, on the ſtone or medal, to the thickneſs of about the tenth part of an inch; they then leave it expoſed to the ſun, in a place free from duſt. After a few days this paſte becomes hard, and offers to the eye the moſt admirable and faithful repreſentation of the medal that it is poſſible to conceive: they are then carefully placed in drawers; and thouſands of thoſe impreſſions, which comprehend many ages, may be included in a ſmall compaſs.

The proficients in plaſtics have likewiſe invented the art of caſting in a mould papier maché or diſſolved paper, and forming it into figures in imitation of ſculpture, of ornaments and decorations for ceilings, furniture, &c. and which they afterwards paint or gild. There are, however, ſome inconveniences attending this art; as, for example, the imperfections in the moulds, which render the contours of the figures inelegant, and give them a heavy air: theſe ornaments, moreover, are not ſo durable as thoſe of bronze or wood, ſeeing that in a few years they are preyed on by the worm.

The figures that are given to porcelain, Delft ware, &c. belong alſo to plaſtics; for they are formed by moulds, as well as by the art of the ſculptor and turner; and by all theſe arts united are made vaſes of every kind, figures, groups, and other deſigns, either for uſe or ornament.

From this general article the reader is referred to Foundery, Cast, Glazing, Porcelain, *Papier-Maché*, Pottery, *Delft Ware*.

PLATA, the name of a very great river of South America, running through the province of Paraguay; whence the whole country is ſometimes called *Plata;* though this name is uſually beſtowed only upon a part of Paraguay. In the latter ſenſe it comprehends all that country bounded on the eaſt and ſouth-eaſt by the Atlantic Ocean; on the ſouth, by Terra Magellanica; on the weſt by Tucuman; and on the north, by the provinces of Paraguay Proper and Parana. The great river La Plata, from which the country has its name, was firſt diſcovered in 1515, by Juan Diaz de Solis; but denominated *La Plata* by Sebaſtian Gabato, from the great quantity of the precious metals he procured from the adjacent inhabitants, imagining it was the produce of the country, though in fact they brought it from Peru.

The country lies between 32° and 37° of ſouth latitude. The climate is pleaſant and healthy. Their winter is in May, June, and July, when the nights are indeed very cold, but the days moderately warm; the froſt is neither violent nor laſting, and the ſnows are very inconſiderable.

The country conſiſts moſtly of plains of a vaſt extent, and exceeding rich ſoil, producing all ſorts of European and American fruits, wheat, maize, cotton, ſugar, honey, &c. and abounding with ſuch excellent paſtures, that the beaſts brought hither from Spain are multiplied to ſuch a degree, that they are all in common, no man claiming any property in them, but every man takes what he hath occaſion for. The number of black cattle, eſpecially, is ſo prodigious, that many thouſands of them are killed merely for their hides, every time the ſhips go for Spain, and their carcaſes left to be devoured by wild beaſts and birds of prey, which are alſo very numerous. Sometimes, when they cannot vend their hides, they will kill them for their tongues; and thoſe who care not to be at the trouble to fetch them from the plains, may buy them for a trifle. There is a curious account in Lord Anſon's voyage of the manner of hunting them on horſeback; and of catching and killing them, by throwing a nooſe on their horns at full gallop, the horſes being trained to the ſport. Horſes are no leſs numerous, and in common like the other cattle; ſo that a man may have as many as he pleaſes for the catching; and of thoſe that are already broke, one may buy ſome of the beſt, and of the true Spaniſh breed, for a piece-of-eight per head. Wild-fowl alſo is in great plenty here; partridges in particular are more numerous, and as large and tame as our hens, ſo that one may kill them with a ſtick. Their wheat makes the fineſt and whiteſt of bread; and, in a word, they ſeem to want for nothing here, eſpecially the natives, but ſalt and fuel. The former the Spaniards have brought to them from other parts; and the latter they ſupply themſelves with, by planting vaſt numbers of almond, peach, and other trees, which require no other trouble than putting the kernels into the ground, and by the next year, we are told, they begin to bear fruit. The return for European commodities is ſo great here, that it almoſt exceeds belief; an ordinary two-penny knife fetching a crown, and a gun of the value of 10 or 12 ſhillings 20 or 30 crowns, and ſo of the reſt.

The river Plata riſes in Peru, and receives a great many others in its courſe; the chief of which is the Paraguay. The water of it is ſaid to be very clear and ſweet, and to petrify wood; and contains ſuch plenty and variety of fiſh, that the people catch great quantities of them without any other inſtrument than their hands. It runs moſtly to the ſouth and ſouth-eaſt; and is navigable the greater part of its courſe by the largeſt veſſels, and full of delightful iſlands. All along its banks are ſeen the moſt beautiful birds of all kinds; but it ſometimes overflows the adjacent country to a great extent, and is infeſted by ſerpents of a prodigious bigneſs. From its junction with the Paraguay to its mouth is above 200 leagues. We may form ſome judgement of its largeneſs by the width of its mouth, which is ſaid to be about 70 leagues. Before it falls into the Paraguay it is called *Panama*. See PANAMA.

PLATÆÆ (anc. geog.), a very ſtrong town of Bœotia, in its ſituation expoſed to the north wind (Theophraſtus); burnt to the ground by Xerxes (Herodotus, Juſtinus); mentioned much in the courſe of the Perſian war: Famous for the defeat of Mardonius, the Perſian general; and for the moſt ſignal victory of the Lacedemonians and other Greeks under Pauſanias the Lacedemonian, and Ariſtides an Athenian general (Nepos, Diodorus, Plutarch); in memory of which the Greeks erected a temple to Jupiter Eleutherius, and inſtituted games which they called *Eleutheria;* and there they ſhow the tombs of thoſe who fell in that battle (Strabo). It ſtood at the foot of mount Cithæron, between that and Thebes to the north, on the road to Athens and Megara, and on the confines of Attica and Megaris. Now in ruins.

PLATALEA, the SPOONBILL, in ornithology, a genus belonging to the order of grallæ. The beak is plain, and dilates towards the point into an orbicular form; the feet have three toes, and are half palmated. There are three ſpecies diſtinguiſhed by their colour: and of theſe ſpecies there are three varieties; two of which is called the *white ſpecies*, and one of the *roſeate*.

Plate CCCXCVII.

1. The white ſpecies, which Linnæus calls *platalea leucorodia*, is about the ſize of a heron, but ſomewhat ſhorter in the neck and legs. The bill is more than half a foot long, and, like that of the reſt of the genus, is ſhaped like a ſpoon: the colour of the bill is very various, being in ſome birds black, in others brown, and ſometimes ſpotted; from the baſe to two-thirds of its length ſeveral indentations croſs it, the riſing parts of which are of a dark colour: the tongue is ſhort and heart-ſhaped: the irides are grey: the ſkin of the lore round the eyes and of the throat is bare and black: the plumage is entirely white, though there have been ſpecimens where the quills were tipped with black: the legs are generally either black or of a greyiſh brown colour; between the toes there is a membrane connected to the outer one as far as the ſecond, and to the inner as far as the firſt joint.

"This bird (ſays Mr Latham) is found in various parts of the old continent, and from the Ferro iſles near Iceland to the Cape of Good Hope. It frequents the neighbourhood of the ſea; and has been met with on the coaſts of France: at Sevenhuys, near Leyden, once in great plenty, annually breeding in a wood there. The neſt is placed on high trees near the ſea-ſide. The female lays three or four white eggs, powdered with a few pale red ſpots, and of the ſize of thoſe of an hen. They are very noiſy during breeding-time, like our rooks; are ſeldom found high up the rivers, chiefly frequenting the mouths of them. Their food is fiſh, which they are ſaid not unfrequently to take from other birds, in the manner of the bald eagle; alſo muſcles and other ſhell-fiſh being found in greateſt numbers where theſe are plenty; and they will alſo devour frogs and ſnakes, and even graſs and weeds, which grow in the water, as well as the roots of reeds. They are migratory, retiring to the warmer parts as the winter approaches, and are rarely ſeen in England. Their fleſh is ſaid to have the flavour of a gooſe, and is eaten by ſome, and the young birds have been thought good food. By many authors they are called *pelicans*."

The two varieties of this ſpecies are equal in ſize to the roſeate ſpecies. The bill of the firſt is reddiſh; the plumage moſtly white; the feathers of the wings partly white and partly black, and the legs reddiſh. The plumage of the other is entirely white, not excepting even the quills. It has a creſt of feathers whoſe webs are very looſe, and ſeparated from one another; the bill is of a rufous grey colour, having red edges, and the legs are of a dull pale red. They both inhabit the *Philippine iſlands*.

2. The roſeate ſpecies, or *platalea ajaja*, is but a little leſs than the white. The bill is marked all round with a furrow parallel to the edge, and is of a greyiſh white colour, ſo tranſparent as to ſhow the ramification of the blood-veſſels belonging to it: the forehead is of a whitiſh colour between the bill, and eyes, and throat: the plumage is a fine roſe-colour, deepeſt on the wings: the legs are grey; the claws blackiſh; and the toes have membranes as in the laſt ſpecies. The variety of this ſpecies is entirely of a beautiful red colour, having a collar of black at the lower part of the neck; the irides are red. Mr Latham imagines it is the roſeate in full plumage. It is ſaid to be of a blackiſh cheſnut the firſt year; becomes roſe-coloured the ſecond, and of a deep ſcarlet the third. It lives on ſmall fiſh.

3. The dwarf ſpecies, or *platalea pigmea*, is about the ſize of a ſparrow. The bill is black, longer than the head, flat at the end, and nearly of a rhomboidal form; the angles and top of the upper mandible are white; the tongue is ſmooth; the body is brown above and white beneath; the quills have white ſhafts; the tail is rounded, ſhort, and of a browniſh white colour; the feet have four toes, are cloven, and the claws are pointed. It inhabits Surinam and Guiana.

PLATANUS, the Plane-tree; a genus of the polyandria order, belonging to the monœcia claſs of plants.

Species. 1. The orientalis, oriental or eaſtern plane-tree, riſes with a very ſtraight ſmooth branching ſtem to a great height. It has palmated leaves, ſix or eight inches long and as much broad, divided into five large ſegments, having the ſide ones cut into two ſmaller, green above, and pale underneath; and long pendulous pedunculi, each ſuſtaining ſeveral round heads of cloſe-ſitting very ſmall flowers; ſucceeded by numerous downy ſeeds, collected into round, rough, hard balls. It is a native of Aſia and many parts of the eaſt, and grows in great plenty in the Levant. 2. The occidentalis, occidental, or weſtern plane-tree, riſes with a ſtraight ſmooth ſtem, to a great height, branching widely round: it has lobated leaves, ſeven or eight inches long, and from nine or ten to twelve or fourteen broad, divided into three large lobes; and very ſmall flowers, collected into round heads, ſucceeded by round rough balls of ſeed. It is a native of Virginia and other parts of North America; where it attains an enormous ſize, and is remarkable for having its ſtem all of an equal girt for a conſiderable length: we have an account of ſome trees being eight or nine yards in circumference, and which, when felled, afforded 20 loads of wood. The varieties of theſe two ſpecies are the Spaniſh or middle plane-tree, having remarkably large leaves of three or five narrower ſegments; and the maple-leaved plane-tree, having ſmaller leaves, ſomewhat lobated into five ſegments, reſembling the maple-tree leaf.

All theſe elegant trees are of hardy temperature, ſo as to proſper here in any common ſoil and expoſure in our open plantations, &c. and are ſome of the moſt deſirable trees of the deciduous tribe. They were in ſingular eſteem among the ancients of the eaſt, for their extraordinary beauty, and the delightful ſhade they afforded by their noble foliage. The leaves commonly expand in May, and fall off early in autumn; and the flowers appear in ſpring, a little before the leaves, being ſucceeded by ſeeds, which in fine ſeaſons frequently ripen in September. Theſe fine trees are ſingularly fitted for all ornamental plantations. Their ſtraight growth, regular branching heads, and the lofty ſtature they attain, together with the extraordinary breadth of their luxuriant leaves, render them extremely deſirable furniture to adorn avenues, lawns, parks, and woods; ſome diſpoſed in ranges, ſome as ſingle ſtandards, others in clumps, ſome in groves, &c. They are moſt excellent for ſhade; for it is obſervable, that no tree is better calculated to defend us from the heat in ſummer, by its noble ſpreading foliage, and to admit the ſun's rays more freely in winter, on account of the diſtance of its branches, which is always in proportion to the ſize of the leaves. They may alſo be employed in the collection of foreſt-trees, in woods, to grow up to timber, in which caſe they will alſo prove advantageous in time. In ſhort, theſe noble trees claim the eſteem of every one concerned in plantations of every kind; but more particularly in extenſive ones, where they may be ſo variouſly diſpoſed as to have a charming effect.

The *propagation* of theſe trees is by ſeed, layers, and cuttings. The ſeeds frequently ripen in theſe parts, and are alſo procured from other countries, and may be obtained of the nurſerymen or ſeedſmen. The beſt ſeaſon for ſowing them is autumn, if they can be then poſſibly procured. Chooſe a ſomewhat ſhady moiſt ſoil; and having dug the ground, and raked it fine, form it into four-feet wide beds, and either ſcatter the ſeeds evenly on the ſurface and rake them in, or previouſly with the back of a rake turn the earth off the ſurface near half an inch deep into the alleys; then ſow the ſeed, and directly, with the rake turned the proper way, draw the earth evenly over the ſeeds, and trim the ſurface ſmooth: many of the plants will riſe in ſpring, and probably many not till the ſpring following. When they are one or two years old, plant them out in nurſery rows, two or three feet aſunder, and about half that diſtance in the lines; here to remain till of a proper ſize for final tranſplantation. The method of propagation by layers is very commonly practiſed in the nurſeries, in default of ſeed, and by which they moſt readily grow; for which purpoſe, ſome ſtout plants for ſtools muſt be planted, which in a year after muſt be headed down near the bottom, that they may throw out many ſhoots near the ground, convenient for laying; which, in the autumn after they are produced, lay by for ſlit-laying; and by autumn after, they will be well rooted, and form plants two or three feet high, ſo may be ſeparated, and planted in nurſery rows like the ſeedlings. All the ſorts will take tolerably by cutting off the ſtrong young ſhoots; but the *platanus occidentalis* more freely than the oriental kind. Autumn is the beſt ſeaſon: as ſoon as the leaf falls, chooſe ſtrong young ſhoots, and plant them in a moiſt ſoil; many of them will grow, and make tolerable plants by next autumn. It ſhould be remarked, that, in order to continue the diſtinction of the varieties more effectually, they ſhould be propagated either by layers or cuttings: for when raiſed from ſeed, thoſe of the reſpective ſpecies generally vary.

PLATBAND, in gardening, a border or bed of flowers, along a wall, or the ſide of a parterre, frequently edged with box, &c.

PLATBAND of a door or window, is uſed for the lintel, where that is made ſquare, or not much marked.

PLATE, a term which denotes a piece of wrought ſilver, ſuch as the ſhallow veſſel off which meat is eaten. It is likewiſe uſed by Britiſh ſportſmen to expreſs the reward given to the beſt horſe at their races.

Sportſman's Dictionary.

The winning a plate is not the work of a few days to the owner of the horſe; but great care and preparation is to be made for it, if there is any great dependence on the ſucceſs. A month is the leaſt time that can be allowed to draw the horſe's body clear, and to refine his wind to that degree of perfection that is attainable by art.

It is firſt neceſſary to take an exact view of his body, whether he be low or high in fleſh; and it is alſo neceſſary to conſider whether he be dull and heavy, or briſk and lively when abroad. If he appear dull and heavy, and there is reaſon to ſuppoſe it is owing to too hard riding, or, as the jockeys expreſs it, to ſome greaſe that has been diſſolved in hunting, and has not been removed by ſcouring, then the proper remedy is half an ounce of diapente given in a pint of good ſack; this will at once remove the cauſe, and revive the creature's ſpirits. After this, for the firſt week of the month, he is to be fed with oats, bread, and ſplit beans; giving him ſometimes the one and ſometimes the other as he likes beſt; and always leaving ſome in the locker, that he may feed at leiſure when he is left alone. When the groom returns at the feeding-time, whatever is left of this muſt be removed, and freſh given; by this means the creature will ſoon become high-ſpirited, wanton, and full of play. Every day he muſt be rode out an airing, and every other day it will be proper to give him a little more exerciſe; but not ſo much as to make him ſweat too much. The beans and oats in this caſe are to be put into a bag, and beaten till the hulls are all off, and then winnowed clean; and the bread, inſtead of being chipped in the common way, is to have the cruſt clean cut off. If the horſe be in good fleſh and ſpirits when taken up for its month's preparation, the diapente muſt be omitted; and the chief buſineſs will be to give him good food, and ſo much exerciſe as will keep him in wind, without overſweating him or tiring his ſpirits. When he takes larger exerciſes afterwards, towards the end of the month, it will be proper to have ſome horſes in the place to run againſt him. This will put him upon his mettle, and the beating them will give him ſpirits. This, however, is to be cautiouſly obſerved, that he has not a bloody heat given him for ten days or a fortnight before the plate is to be run for; and that the laſt heat that is given him the day before the race, muſt be in his clothes: this will make him run with greatly more vigour, when ſtripped for the race, and feeling the cold wind on every part.

In the ſecond week, the horſe ſhould have the ſame food and more exerciſe. In the laſt fortnight he muſt have dried oats that have been hulled by beating. After this they are to be wetted in a quantity of whites of eggs beaten up, and then laid out in the ſun to dry; and when as dry as before, the horſe is to have them. This ſort of food is very light of digeſtion, and very good for the creature's wind. The beans in this time ſhould be given more ſparingly, and the bread ſhould be made of three parts wheat and one part beans. If he ſhould become coſtive under this courſe, he muſt then have ſome ale and whites of eggs beaten together; this will cool him, and keep his body moiſt.

In the laſt week the maſh is to be omitted, and barley-water given him in its place, every day, till the day before the race: he ſhould have his fill of hay; then he muſt have it given him more ſparingly, that he may have time to digeſt it; and in the morning of the race day he muſt have a toaſt or two of white bread ſoaked in ſack, and the ſame juſt before he is let out to the field. This is an excellent method, becauſe the two extremes of fullneſs and faſting are at this time to be equally avoided; the one hurting his wind, the other occaſioning faintneſs that may make him loſe. After he has had his food, the litter is to be ſhook up, and the ſtable kept quiet, that he may be diſturbed by nothing till he is taken out to run.

PLATFORM, in the military art, an elevation of earth, on which cannon is placed to fire on the enemy; ſuch are the mounts in the middle of curtins. On the ramparts there is always a platform, where the cannon are mounted. It is made by the heaping up of earth on the rampart, or by an arrangement of madriers, riſing inſenſibly for the cannon to roll on, either in a caſemate or on attack in the outworks. All practitioners are agreed, that no ſhot can be depended on, unleſs the piece can be placed on a ſolid platform; for if the platform ſhakes with the firſt impulſe of the powder, the piece muſt likewiſe ſhake, which will alter its direction, and render the ſhot uncertain.

PLATFORM, in architecture, is a row of beams which ſupport the timber-work of a roof, and lie on the top of a wall where the entablature ought to be raiſed.

This term is alſo uſed for a kind of terrace or broad ſmooth open walk at the top of a building, from whence a fair proſpect may be taken of the adjacent country. Hence an edifice is ſaid to be covered with a platform, when it is flat at top and has no ridge. Moſt of the oriental buildings are thus covered, as were all thoſe of the ancients.

PLATFORM, or *Orlop*, in a man of war, a place on the lower deck, abaft the main-maſt, between it and the cockpit, and round about the maincapſtan, where proviſion is made for the wounded men in time of action.

PLATINA is a metallic-ſubſtance lately diſcovered. The name, which has an alluſion to its colour, is a diminutive of *plata*, and ſignifies "little ſilver." From its great ſpecific gravity, and other reſemblances which it has to gold, it has been called *or blanc*, or *white gold*; from its refractory nature, *diabolus metallorum*; from ſome doubts entertained of its character as a metal, *juan blanco*, *white jack*, *white rogue*, or *white mock metal*. It has alſo received the appellation of the *eighth metal*; and, probably from ſome diſtrict which affords it, has gotten the name of *platina del Pinto*.

The firſt in Europe who mentioned it by its preſent name was Don Antonio Ulloa, a Spaniſh mathematician, who in 1735 accompanied the French academicians that were ſent by their ſovereign to determine the figure of the earth by meaſuring a degree of the meridian in Peru. In the relation of his voyage, which was publiſhed at Madrid in 1748, he ſays, that the golden mines in the territory of Choco had been abandoned on account of platina; which he repreſents as a hard ſtone not eaſily broken by a blow on the anvil, which could not be ſubdued by calcination, and from which the gold could not be extracted without much labour, much expence, and great difficulty.

The particular places of Choco where it is found are Novita and Citara; but in what quantity it is there to be met with is not aſcertained. The miners, diſcovering at an early period that it was a metal, had begun to employ it in adulterating their gold; and the court of Spain, it is ſaid, dreading the conſequences, took meaſures not only to prevent its exportation, but partly to conceal the knowledge of it from the world. It is reported in the Chemical Annals for July 1792, that when the gold is brought from Choco to be coined in the two mints of Santa-fe, in that of Bogota and Popayan, the gold undergoes a new examination, the platina that remains is carefully ſeparated, and being given to officers appointed by the king, they, as ſoon as a certain quantity is collected, carry it away, and before witneſſes throw it into the river Bogoto, at two leagues diſtance from Santa-fe, or into the Cauca, about one league diſtant from Popayan.

In the Phyſical Journals for November 1785 we are told, that the primitive mines which produced it have not yet been diſcovered in any part of the globe, and that thoſe which furniſh it at preſent are of the ſecondary kind, being ſtrata of looſe earth waſhed down from the higher grounds. In theſe ſtrata the particles are reported to be from the ſize of a millet ſeed to that of a pea. The author of the account ſays, that he had ſome pieces which weighed from 15 to 20 grains; and adds, that on trying ſome of them between ſteel-rollers, in the preſence of Meſſrs. Darcet and Tillet at Paris, they were perfectly laminated. He ſays alſo, that a native piece of platina was found nearly of a ſquare figure, and almoſt as large as a pigeon's egg, which was depoſited in the Royal Society of Biſcay. M. de Buffon, however, ſays expreſsly, that "a perſon of credit had aſſured him that platina is ſometimes found in large maſſes; and that he had ſeen a lump of it weighing no leſs than 20 lib. which had not been melted, but taken in that ſtate out of the mine." As to the ſmall particles, they are of a whiter colour than iron, with a ſmooth ſurface. Their figure is generally of an oblong form, very flat, rounded in the edge, and has been aſcribed to the hammering of the mills in which the gold is amalgamated.

The heterogeneous ſubſtances with which the platina is generally mixed are particles of gold, grains of quartz or cryſtal, ſome ſand of a browniſh hue, and ſome duſt of a dark colour obedient to the magnet, and which ſeems to be fragments of other irregular dark-coloured particles, which reſemble pieces of emery or loadſtone. Dr Ingenhouſz, however, ſays, that every particle even of ſome fine platina which he examined obeyed the magnet more or leſs, excepting ſome that were tranſparent and ſtony; and that theſe were all magnets in themſelves, or that each of theſe particles had two poles, which he could change at pleaſure by magnetic bars. In about 72 pounds weight of platina which was brought from Spaniſh America, M. Magellan found not only a large quantity of ferruginous ſand, but many pieces of vegetable ſtalks, a number of ſeeds, and ſome very ſmall red cryſtals like rubies. Theſe cryſtals being ſent to M. Achard of Berlin, he tried them as far as their minuteneſs and ſmall quantity would permit, and at laſt concluded that they really were rubies. As for the mercurial globules which are ſometimes intermixed with the particles of platina, they are entirely foreign to its mines. They are now generally thought to be part of the mercury that has been employed in amalgamation; and which could not be brought from a place leſs diſtant than Guancavelica, about 900 miles from the province of Choco where the platina is found.

This metal, though not under its preſent name, which was firſt mentioned by Don Ulloa, has perhaps been known in Europe ſince 1741. At that period Charles Wood found in Jamaica ſome platina which was brought from Carthagena. He even made ſome chemical trials of it. Among others, he attempted to cupel it; and obſerves, in the account which he gave of it in 1749, that the Spaniards had a method of caſting it into different ſorts of toys, which are common enough in the Spaniſh Weſt Indies. It was probably, too, imported into Spain ſoon after its diſcovery in America. It is ſaid that Rudenſchoel carried ſome of it from Spain to Stockholm in 1745; and the firſt important ſet of experiments that appeared on the ſubject were thoſe of Scheffer, one of the members of the Swediſh Academy. They were publiſhed in 1752; and gave this information, that platina is eaſily fuſible with arſenic, but when alone remains unchanged by the moſt violent heat of the furnace. Two years after Dr Lewis publiſhed ſome papers concerning this metal in the Royal Philoſophical Tranſactions of London. This eminent chemiſt, in the courſe of his experiments, had examined it both in the dry and the wet way; diſcovered a number of its relative affinities; mixed it in different proportions with different metals; and had fuſed it with arſenic, though he did not afterwards attempt to ſeparate them.

In 1757 Margraaf publiſhed ſeveral very intereſting obſervations about the method of ſeparating it from the iron which always accompanies it.

In 1758 and 1763 Macquer and Beaumé made upon it a conſiderable number of experiments together, and formed of it at laſt a concave mirror. See Chemiſtry, nº 1321.

And it was in 1780 that the *Journaux de Phyſique* gave an account of the labours of Bergman on the ſame ſubject.

The platina of which the toys were made in the Spaniſh Weſt Indies was found by Dr Lewis to be always mixed with ſome other metals. Ib. nº 1339—1347. What theſe particular mixtures were is not well known; but many of the allays formed by Dr Lewis himſelf have promiſed to be both ornamental and uſeful. He found that platina, which is $\frac{1}{7}$ of the whole maſs, will render gold no paler than a guinea, which contains only $\frac{1}{12}$ of ſilver. He found that copper was much improved by allaying it with platina in certain proportions; and that equal parts of platina and braſs formed a compound not ſubject to tarniſh, and which might be employed with great advantage for the ſpeculums of teleſcopes.

Beſides allaying it with the different metals, it was an object equally intereſting to the chemiſts and ſociety that platina ſhould be obtained pure and unmixed; and that means ſhould be contrived to render it fuſible, malleable, and ductile. We are now to ſee what the chemiſts have done to accompliſh theſe ends. They readily ſaw that it would be neceſſary, in the firſt place, to bring it to a ſtate of ultimate diviſion, and that this ſhould be tried in one or other of theſe two ways; by diſſolving it in acids, or by fuſing it along with ſome other metal; for by itſelf it had hitherto proved abſolutely unfuſible, except when expoſed to the focus of a large burning glaſs, or the kindled ſtream of dephlogiſticated or vital air. Among the methods which they employed to ſeparate it from gold, the principal were the following: The firſt was by uniting the mixture of platina and gold with mercury, and grinding the amalgam for a conſiderable time with water in which proceſs the platina was gradually thrown out, and the gold retained by the quickſilver. Another method was by mixing a few drops of a ſolution of platina with above a hundred times the quantity of a ſolution of gold, and gradually adding a pure fixed alkaline ſalt as long as it occaſioned any efferveſcence or precipitation. The remaining liquor in this caſe was ſo yellow, that it has been judged the platina would diſcover itſelf, though its proportion had been leſs than a thouſandth part of that of gold. A third mode of ſeparating platina and gold was that of precipitation, by means of mineral fixed alkali; for when this alkali is mixed with a ſolution of gold containing platina, the gold alone is precipitated, and all the platina remains diſſolved. Another method was by precipitation of the platina with ſal ammoniac. For this purpoſe to a ſolution of the metal in aqua regia a ſmall quantity of the ſolution of ſal ammoniac in water was added; and if the gold contained any platina, the liquor inſtantly grew turbid, and a fine yellow or reddiſh precipitate quickly fell to the bottom; if the gold was pure, no precipitation or change of tranſparency enſued. The fifth method of ſeparation was by means of inflammable liquors. The compound to be examined was diſſolved in aqua regia: the ſolution mingled with twice its quantity or more of rectified ſpirit of wine, and the mixture ſuffered to ſtand for ſome days in a glaſs ſlightly covered, the gold roſe to the ſurface, leaving the platina diſſolved. Otherwiſe, to the ſolution of the metal in aqua regia about half its quantity of any colourleſs eſſential oil was added: the two were ſhaken well together, and ſuffered to reſt; upon which the oil roſe immediately to the ſurface, carrying the gold with it, and leaving the platina diſſolved in the acid under it. Or, the gold was taken up ſtill more readily and more perfectly by ether, or the etherial ſpirit of wine. But, after all, the moſt effectual and advantageous method of ſeparating platina from gold was founded on a property which gold has, and not platina, of being capable of precipitation from aqua regia by martial vitriol; and upon a property which platina has, and not gold, of being capable of precipitation from aqua regia by ſal ammoniac. When therefore we would diſcover if gold be allayed with platina, let it be diſſolved in aqua regia; and to this ſolution, which will contain both metals, let ſome ſal ammoniac diſſolved in water be added; upon which the platina will be precipitated in form of a brick-coloured ſediment. If, on the other ſide, we would know if platina contain any gold, let this platina be diſſolved in aqua regia, and to the ſolution add a ſolution of martial vitriol in water; upon which the liquor will become turbid, and the gold will form a precipitate which may be eaſily ſeparated by decanting and filtrating the liquor. This property which platina poſſeſſes of being precipitated by martial vitriol was firſt diſcovered by M. Sheffer.

With reſpect to the iron contained among the platina, M. de Buffon ſeparated, by means of a magnet, ſix parts out of ſeven of a parcel of platina. He diſtinguiſhed two different matters in platina; of which one was black, friable, and attractable by magnets; and the other conſiſted of larger grains, was of a livid white or yellowiſh colour, much leſs attractable, and was extenſible. Between theſe two different matters were many intermediate particles, ſome partaking more of the former and ſome of the latter. He thought that the black matter was chiefly iron; and ſays, that he had obſerved a ſimilar black powder in many ores of iron.

M. Morveau found, that a Pruſſian blue could be obtained from the black part of the platina, by pouring upon it ſpirit of nitre, and afterwards adding to the ſolution diluted ſome phlogiſticated alkali; and that the particles of platina which could not be attracted by magnets, did not by this method ſhow any ſign of their containing iron.

But the moſt important diſcovery concerning the ſeparation of platina from other metals was a method of melting it, by which it became a perfect metal, malleable, and denſer than gold. It was in 1773 and 1774 that M. de Liſle effected this, by diſſolving crude platina in aqua regia, precipitating it from the acid menſtruum by ſal ammoniac, and by fuſing this precipitate, without addition, in a double crucible, expoſed to the intenſe heat of a forge-fire excited by double bellows. M. Morveau has repeated the experiment, and found that he could melt the precipitate with ſeveral fluxes; he found likewiſe that by means of white glaſs, borax, and charcoal, he could melt even crude platina, and could allay together platina and ſteel in various proportions.

M. de Sickengen was the inventor of another method: he diſſolved his platina in aqua regia, and precipitated the iron by the pruſſiate of potaſs. In evaporating this liquor he obtained ſmall octaedral cryſtals of the colour of rubies; which, being expoſed to a ſtrong heat, yielded a metal which bore eaſily the ſtroke of the hammer, which could be readily drawn into wire, and was extremely malleable.

In attempting to refine platina by the dry way, cupellation was a method to which the chemiſts early had recourſe; but, notwithſtanding their utmoſt endeavours, it has not been attended with all the ſucceſs which could have been wiſhed. It was found that the ſcorification proceeded as well at the beginning of the operation, as when gold and ſilver are cupelled: but the cupellation afterwards became more and more difficult; becauſe, as the quantity of lead diminiſhed, the matter became leſs and leſs fuſible, and at laſt ceaſed to be fluid, notwithſtanding the moſt violent heat; and alſo becauſe, when the quantity of platina was greater than that of the lead, this latter metal was protected, and not converted into litharge. Hence the regulus obtained was always dark-coloured, rough, adhering to the cupel, brittle, and weighing more than the platina originally employed, from the lead which remained united with it. Meſſ. Macquer and Beaumé appear nevertheleſs to have carried this experiment further: they kept the matter expoſed to a violent fire during a longer time; that is, about 50 hours ſucceſſively: and therefore, although their platina was tarniſhed and rough on its ſurface, it was internally white and ſhining, eaſily ſeparable from the cupel, and a little diminiſhed in weight; a certain proof that no lead remained in it. This platina was alſo ductile, and capable of extenſion under the hammer.

Cupellation, therefore, though not the beſt, is at leaſt a certain method of applying platina to uſe, and of forming it into utenſils.

What has been thought a preferable method, is firſt to fuſe the platina with arſenic, and afterwards diſſipate this laſt metal by a ſtrong heat: by this means Achard and Rochon were able to obtain a pure platina; of which the former made ſome ſmall crucibles, and the latter, by allaying it with copper and tin, ſome large mirrors for reflecting teleſcopes.

Jeanety of Paris has gone ſtill farther: beſides ſnuff-boxes, watch chains, and a coffee-pot of platina prepared by this artiſt, the world has ſeen a lens weighing ſix pounds, a ball weighing nine, and two bars 19 feet long, and weighing no leſs than 11 pounds each. This gentleman has the merit of being the firſt who wrought this metal in the great way. The method he employed was far from being new; it had been ſuggeſted by Scheffer, by Willis, by Margraaf, and was afterwards practiſed by Achard, Morveau, and a great many others, but who always prepared it in very ſmall quantities. In the Chemical Annals for July 1792, the following account of it is given by himſelf.

The platina is firſt pounded in water to diſengage it from the ferruginous and other heterogeneous particles that are mixed with it. "This being done, I take (ſays he) one pound and a half of platina, two pounds of white arſenic in powder, and one pound of purified potaſh. I mix the whole: I put a crucible in the fire capable of containing about 20 pounds; when my furnace and crucible are well-heated, I throw into the crucible one third of the mixture, and apply a good heat; I then add a ſecond quantity and a third, and ſo on, always taking care at every time to mix the whole with a rod of platina. I give now a conſiderable force to the fire; and when I am certain that the whole is completely in a ſtate of fuſion, I withdraw my crucible and leave it to cool. After breaking it I find a button that is well formed and attractable by the magnet. I bruiſe this button into ſmall pieces, and fuſe it a ſecond time in the ſame manner: if this ſecond fuſion, which it generally is, be not ſufficient to effect the ſeparation of the iron from the platina, I fuſe it a third time; but if I be obliged to do it a third time, I always put two buttons together, to ſave at once a crucible and charcoal.

This firſt operation being finiſhed, I take a crucible with a flat bottom and of a circumference to give to the button about three inches and a quarter in diameter. I make this crucible red hot, and throw into it one pound and a half of the platina which has been already fuſed with the arſenic after it was broken into ſmall pieces; to this I add a quantity of arſenic of the ſame weight, and about half a pound of refined potaſh. I give to the fire a conſiderable fore; and when I am certain that the whole is completely in a ſtate of fuſion, I withdraw my crucible and leave it to cool, taking care always to place it horizontally, that the button may be of an equal thickneſs. After breaking the crucible, I find a button clear and ſonorous, and weighing commonly about 1 pound and 11 ounces. I have remarked, that in proportion to the quantity of arſenic combined with the platina, the purification always ſucceds with the more or leſs promptneſs and eaſe; and the greater the proportion ſo much the better. In this ſtate I put my button into a furnace under a muffle, which ought not to be higher than the edge of the button lying on its flat ſide, and inclining a little to the walls of the muffle. In this manner I place three buttons on each ſide of the muffle, and apply fire to my furnace, that the muffle may be equally heated throughout: as ſoon as the buttons begin to evaporate I ſhut the doors of my furnace, that the heat may be kept up to the ſame degree; this ought always to be carefully attended to even to the end of the operation, for even a temporary exceſs of heat might ſpoil the whole of my paſt operations and render them abortive. I cauſe my buttons to volatilize during ſix hours, always taking care to change their ſituation, that every part may receive an equal portion of heat: I then put them in common oil, and for a like time keep them in a fire ſufficient to diſſipate the oil in ſmoke, I continue this operation as long as the button emits vapours; and when the evaporation has ceaſed I puſh the fire as far as it will go by means of the oil. Theſe arſenical vapours have a bright ſhining metallic appearance, which I never can obtain any other way, and without which I have never been able to render platina perfectly malleable.

"If theſe ſteps which are here pointed out be properly followed, the operation laſts only eight days. My buttons are then thrown into the nitrous acid, and afterwards boiled in diſtilled water, till no part of the acid remains with them: I now heap them together one above another, apply the ſtrongeſt poſſible heat, and beat them with a hammer, taking always care at the firſt heat to make them red hot in the crucible, that no foreign bodies may mix with them, as before this compreſſion they are only ſo many ſpongy maſſes. I afterwards heat them in a naked ſtate *(les chauffe à nud)*; and bringing them to a ſquare form, I hammer them on all ſides for a ſhorter or longer time according to their bulk."

Such is the proceſs obſerved by Jeanety in fuſing platina; but he thinks that the working of this metal is ſuſceptible of ſtill greater improvement. In 1788 it was accordingly propoſed by ſome of the French chemiſts to fuſe platina by mixing it with charcoal and phoſphoric glaſs, and afterwards to expoſe the phoſphure of platina to a heat ſufficient to volatilize and diſſipate the phoſphorus. This method ſucceeded remarkably well with M. Pelletier; but, beſides being tedious, it is difficult to ſeparate the laſt portions of the phoſphorus; and as theſe operations are always coſtly, there are few artiſts who are willing to undertake them. M. de Morveau has alſo fuſed platina with his vitreous flux, made of pounded glaſs, borax, and charcoal: and Beaumé has adviſed to fuſe it with a ſlight addition of lead, biſmuth, antimony, or arſenic, and by keeping the alloy in the fire a long time to diſſipate the metals which have facilitated the fuſion. Platina may likewiſe be fuſed with a metal ſoluble in an acid: the mixture being pulverized the alloyed metal may be diſſolved, and the powder of platina may then be fuſed with the flux of De Morveau; or, inſtead of uſing a ſoluble metal, a calcinable metal may be employed, and heated as before †.

The colour of platina, when properly refined, is ſomething between that of iron and ſilver; it has no ſmell, and is the heavieſt body yet known in nature. According to Mr Kirwan its ſpecific gravity is to that of water as 23 to 1. It may likewiſe be ſaid to be the moſt durable of all the metals: it is harder than iron; it undergoes no alteration in the air, and fire alone does not even appear to poſſeſs the power of changing it; for which reaſon it forms the beſt of all crucibles that have yet been invented. It reſiſts the action of acids, alkalis, and ſulphurs: it may be rolled into plates as fine as leaves of gold which are uſed in gilding; it is likewiſe extremely ductile: and Dr Withering tells us, that a wire of platina is ſtronger than a wire of gold or of ſilver of the ſame thickneſs; it is preferable to gold by the property which it has of ſoldering or welding without mixture; and it unites, ſays Chaptal, two qualities never before found in one and the ſame ſubſtance. When formed into a mirror, it reflects but one image, at the ſame time that it is as unchangeable as a mirror of glaſs.

As thoſe motives which at firſt prepoſſeſſed the court of Spain againſt this metal no longer exiſt, it is to be hoped that the decree which was paſſed againſt it will ſoon be revoked, and that the Spaniſh monarch will neither deſpiſe ſo rich a treaſure as his mines of platina, nor refuſe to the world the numerous advantages that may be derived from a ſubſtance that promiſes to be of ſo much importance in commerce and the arts.

PLATING is the art of covering baſer metals with a thin plate of ſilver either for uſe or for ornament. It is ſaid to have been invented by a ſpur-maker, not for ſhow but for real utility. Till then the more elegant ſpurs in common uſe were made of ſolid ſilver, and from the flexibility of that metal they were liable to be bent into inconvenient forms by the ſlighteſt accident. To remedy this defect, a workman at Birmingham contrived to make the branches of a pair of ſpurs hollow, and to fill that hollow with a ſlender rod of ſteel or iron. Finding this a great improvement and being deſirous to add cheapneſs to utility, he continued to make the hollow larger, and of courſe the iron thicker and thicker, till at leaſt he diſcovered the means of coating an iron ſpur with ſilver in ſuch a manner as to make it equally elegant with thoſe which were made wholly of that metal. The invention was quickly applied to other purpoſes; and to numberleſs utenſils which were formerly made of braſs or iron are now given the ſtrength of theſe metals, and the elegance of ſilver, for a ſmall additional expence.

The ſilver plate is generally made to adhere to the baſer metal by means of ſolder; which is of two kinds, the *ſoft* and the *hard*, or the *tin* and *ſilver* ſolders. The former of theſe conſiſts of tin alone, the latter generally of three parts of ſilver and one of braſs. When a buckle, for inſtance, is to be plated by means of the ſoft ſolder, the ring, before it is bent, is firſt tinned, and then the ſilver-plate is gently hammered upon it, the hammer employed being always covered with a piece of cloth. The ſilver now forms, as it were, a mould to the ring, and whatever of it is not intended to be uſed is cut off. This mould is faſtened to the ring of the buckle by two or three cramps of ſmall iron-wire; after which the buckle, with the plated ſide undermoſt, is laid upon a plate of iron ſufficiently hot to melt the tin, but not the ſilver. The buckle is then covered with powdered reſin or anointed with turpentine; and leſt there ſhould be a deficiency of tin, a ſmall portion of rolled tin is likewiſe melted on it. The buckle is now taken off with a tongs, and commonly laid on a bed of ſand, where the plate and the ring, while the ſolder is yet in a ſtate of fuſion, are more cloſely compreſſed by a ſmart ſtroke with a block of wood. The buckle is afterwards bent and finiſhed.

Sometimes the melted tin is poured into the ſilver mould, which has been previouſly rubbed over with ſome flux. The buckle ring is then put among the melted tin, and the plating finiſhed. This is called by the workmen filling up.

When the hard ſolder is employed the proceſs is in many reſpects different. Before the plate is fitted to the iron or other metal, it is rubbed over with a ſolution of borax. Stripes of ſilver are placed along the joinings of the plate; and inſtead of two or three cramps, as in the former caſe, the whole is wrapped round with ſmall wire; the ſolder and joinings are again rubbed with the borax, and the whole put into a charcoal fire till the ſolder be in fuſion. When taken out the wire is inſtantly removed, the plate is cleaned by the application of ſome acid, and afterwards made ſmooth by the ſtrokes of a hammer.

Metal plating is when a bar of ſilver and copper are taken of at leaſt one equal ſide. The equal ſides are made ſmooth, and the two bars faſtened together by wire wrapped round them. Theſe bars are then ſweated in a charcoal fire; and after ſweating, they adhere as cloſely together as if they were ſoldered. After this they are flattened into a plate between two rollers, when the copper appears on one ſide and the ſilver on the other. This ſort of plate is named *plated metal*.

French plating is when ſilver-leaf is burniſhed on a piece of metal in a certain degree of heat.

When ſilver is diſſolved in aquafortis, and precipitated upon another metal, the proceſs is called *ſilvering*. See SOLDERING.

PLATO, an illuſtrious philoſopher of antiquity, was by deſcent an Athenian, though the place of his birth was the Iſland of Egina. His lineage through his father is traced back to Codrus the laſt king of Athens, and through his mother to Solon the celebrated legiſlators. The time of his birth is commonly placed in the beginning of the 88th Olympiad; but Dr Enfield thinks it may be more accurately fixed in the third year of the 87th Olympiad, or 430 years before the Chriſtian era. He gave early indications of an extenſive and original genius, and had an education ſuitable to his high rank, being inſtructed in the rudiments of letters by the grammarian Dionyſius, and trained in athletic exerciſes by

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† Chaptal.

Ariſto of Argos. He applied with great diligence to the ſtudy of the arts of painting and poetry; and made ſuch proficiency in the latter, as to produce an epic poem, which, upon comparing it with the poems of Homer, he committed to the flames. At the age of 20 he compoſed a dramatic piece; but after he had given it to the performers, happening to attend upon a diſcourſe of Socrates, he was ſo captivated by his eloquence, that he reclaimed his tragedy without ſuffering it to be acted, renounced the muſes, burnt all his poems, and applied himſelf wholly to the ſtudy of wiſdom.

It is thought that Plato's firſt maſters in philoſophy were Cratylus and Hermogenes, who taught the ſyſtems of Heraclitus and Parmenides; but when he was 20 years old, he attached himſelf wholly to Socrates, with whom he remained eight years in the relation of a ſcholar. During this period, he frequently diſpleaſed his companions, and ſometimes even his maſter, by grafting upon the Socratic ſyſtem opinions which were taken from ſome other ſtock. It was the practice of the ſcholars of Socrates to commit to writing the ſubſtance of their maſter's diſcourſes. Plato wrote them in the form of dialogues; but with ſo great additions of his own, that Socrates, hearing him recite his Lyſis, cried out, "O Hercules! how many things does this young man feign of me!"

Plato, however, retained the warmeſt attachment to his maſter. When that great and good man was ſummoned before the ſenate, his illuſtrious ſcholar undertook to plead his cauſe, and begun a ſpeech in his defence; but the partiality and violence of the judges would not permit him to proceed. After the condemnation, he preſented his maſter with money ſufficient to redeem his life; which, however, Socrates refuſed to accept. During his impriſonment, Plato attended him, and was preſent at a converſation which he held with his friends concerning the immortality of the ſoul; the ſubſtance of which he afterwards committed to writing in the beautiful dialogue intitled *Phædo*, not, however, without interweaving his own opinions and language.

The philoſophers who were at Athens were ſo alarmed at the death of Socrates, that moſt of them fled from the city to avoid the injuſtice and cruelty of the government. Plato whoſe grief upon this occaſion is ſaid by Plutarch to have been exceſſive, retired to Megara; where he was friendly entertained by Euclid, who had been one of Socrates's firſt ſcholars, till the ſtorm was over. Afterwards he determined to travel in purſuit of knowledge; and from Megara he went to Italy, where he conferred with Eurytus, Philolaus, and Archytas. Theſe were the moſt celebrated of the followers of Pythagoras, whoſe doctrine was then become famous in Greece; and from theſe the Pythagoreans have affirmed that he had all his natural philoſophy. He dived into the moſt profound and myſterious ſecrets of the Pythagoric doctrines; and perceiving other knowledge to be connected with them, he went to Cyrene, where he learned geometry of Theodorus the mathematician. From thence he paſſed into Egypt, to acquaint himſelf with the theology of their prieſts, to ſtudy more nicely the proportions of geometry, and to inſtruct himſelf in aſtronomical obſervations; and having taken a full ſurvey of all the country, he ſettled for ſome time in the province of Sais, learning of the wiſe men there, what they held concerning the univerſe, whether it had a beginning, whether it moved wholly or in part, &c.; and Pauſanias affirms, that he learned from theſe the immortality, and alſo the tranſmigration of ſouls. Some of the fathers will have it, that he had communication with the books of Moſes, and that he ſtudied under a learned Jew of Heliopolis; but there is nothing that can be called evidence for theſe aſſertions. St Auſtin once believed that Plato had ſome conference with Jeremiah; but afterwards diſcovered, that that prophet muſt have been dead at leaſt 60 years before Plato's voyage to Egypt.

Plato's curioſity was not yet ſatisfied. He travelled into Perſia to conſult the magi about the religion of that country: and he deſigned to have penetrated even to the Indies, and to have learned of the Brachmans their manners and cuſtoms; but the wars in Aſia hindered him.

"He then returned into Italy, to the Pythagorean ſchool at Tarentum, where he endeavoured to improve his own ſyſtem, by incorporating with it the doctrine of Pythagoras, as it was then taught by Archytas, Timæus, and others. And afterwards, when he viſited Sicily, he retained ſuch an attachment to the Italic ſchool, that, through the bounty of Dionyſius, he purchaſed at a vaſt price ſeveral books which contained the doctrine of Pythagoras, from Philolaus, one of his followers.

"Returning home richly ſtored with knowledge of various kinds, Plato ſettled in Athens, and executed the deſign, which he had doubtleſs long had in contemplation, of forming a new ſchool for the inſtruction of youth in the principles of philoſophy. The place which he made choice of for this purpoſe was a public grove, called the *Academy*, from Hecademus, who left it to the citizens for the purpoſe of gymnaſtic exerciſes. Adorned with ſtatues, temples, and ſepulchres, planted with lofty plane-trees, and interſected by a gentle ſtream, it afforded a delightful retreat for philoſophy and the muſes. Of this retreat Horace ſpeaks:

Atque inter ſylvas Academi quærere verum,

"'Midſt Academic groves to ſearch for truth."

Within this incloſure he poſſeſſed, as a part of his humble patrimony, purchaſed at the price of three thouſand drachmas, a ſmall garden, in which he opened a ſchool for the reception of thoſe who might be inclined to attend his inſtructions. How much Plato valued mathematical ſtudies, and how neceſſary a preparation he thought them for higher ſpeculations, appears from the inſcription which he placed over the door of his ſchool: 'Ουδεις αγεωμέτρητος εισιτω, "Let no one who is unacquainted with geometry enter here."

"This new ſchool ſoon became famous, and its maſter was ranked among the moſt eminent philoſophers. His travels into diſtant countries, where learning and wiſdom flouriſhed, gave him celebrity among his brethren of the Socratic ſect. None of theſe had ventured to inſtitute a ſchool in Athens except Ariſtippus; and he had confined his inſtructions almoſt entirely to ethical ſubjects, and had brought himſelf into ſome diſcredit by the freedom of his manners. Plato alone remained to inherit the patrimony of public eſteem which Socrates had left his diſciples; and he poſſeſſed talents and learning adequate to his deſign of extending the ſtudy of philoſophy beyond the limits within which it had been incloſed

cloſed by his maſter. The conſequence was, not only that young men crowded to his ſchool from every quarter, but that people of the firſt diſtinction in every department frequented the academy. Even females, diſguiſed in mens clothes, often attended his lectures. Among the illuſtrious names which appear in the catalogue of his followers are Dion the Syracuſan prince, and the orators Hyperides, Lycurgus, Demoſthenes, and Iſocrates.

“ Greatneſs was never yet exempted from envy. The diſtinguiſhed reputation of Plato brought upon him the hatred of his former companions in the ſchool of Socrates, and they loaded him with detraction and obloquy. It can only be aſcribed to mutual jealouſy, that Xenophon and he, though they relate the diſcourſes of their common maſter, ſtudiouſly avoid mentioning one another. Diogenes the Cynic ridiculed Plato's doctrine of ideas and other abſtract ſpeculations. In the midſt of theſe private cenſures, however, the public fame of Plato daily increaſed; and ſeveral ſtates, among which were the Arcadians and Thebans, ſent ambaſſadors with earneſt requeſts that he would come over, not only to inſtruct the young men in philoſophy, but alſo to preſcribe them laws of government. The Cyrenians, Syracuſians, Cretans, and Eleans, ſent alſo to him: he did not go to any of them, but gave laws and rules of governing to all. He lived ſingle, yet ſoberly and chaſtly. He was a man of great virtues, and exceedingly affable; of which we need no greater proof, than his civil manner of converſing with the philoſophers of his own times, when pride and envy were at their height. His behaviour to Diogenes is always mentioned in his hiſtory. The Cynic was vaſtly offended, it ſeems, at the politeneſs and fine taſte of Plato, and uſed to catch all opportunities of ſnarling at him. He dined one day at his table with other company, and, trampling upon the tapeſtry with his dirty feet, uttered this brutiſh ſarcaſm, “I trample upon the pride of Plato;” to which Plato wiſely reparteed, “ With greater pride.”

The fame of Plato drew diſciples to him from all parts; among whom were Speuſippus an Athenian, his ſiſter's ſon, whom he appointed his ſucceſſor in the academy and the great Ariſtotle.

The admiration of this illuſtrious man was not confined to the breaſts of a few philoſophers. He was in high eſteem with ſeveral princes, particularly Archelaus king of Macedon, and Dionyſius tyrant of Sicily. At three different periods he viſited the court of the latter prince, and made ſeveral bold but unſucceſsful attempts to ſubdue his haughty and tyrannical ſpirit. A brief relation of the particulars of theſe viſits to Sicily may ſerve to caſt ſome light upon the character of our philoſopher; and we ſhall give it in the words of Dr Enfield, from whoſe elegant hiſtory of philoſophy we have extracted by much the moſt valuable parts of this article.

“ The profeſſed object of Plato's firſt viſit to Sicily, which happened in the 40th year of his age, during the reign of the elder Dionſius the ſon of Hermocrates, was, to take a ſurvey of the iſland, and particularly to obſerve the wonders of Mount Ætna. Whilſt he was reſident at Syracuſe, he was employed in the inſtruction of Dion, the king's brother-in-law, who poſſeſſed excellent abilities, though hitherto, reſtrained by the terrors of a tyrannical government, and relaxed by the luxuries of licentious court. Diſguſted by the debauched manners of the Syracuſans, he endeavoured to reſcue his pupil from the general depravity. Nor did Dion diſappoint his preceptor's expectations. No ſooner had he received a taſte of that philoſophy which leads to virtue, then he was fired with an ardent love of wiſdom. Entertaining an hope that philoſophy might produce the ſame effect upon Dionyſius, he took great pains to procure an interview between Plato and the tyrant. In the courſe of the conference, whilſt Plato was diſcourſing on the ſecurity and happineſs of virtue, and the miſeries attending injuſtice and oppreſſion, Dionyſius, perceiving that the philoſopher's diſcourſe was levelled againſt the vices and cruelties of his reign, diſmiſſed him with high diſpleaſure from his preſence, and conceived a deſign againſt his life. It was not without great difficulty that Plato, by the aſſiſtance of Dion, made his eſcape. A veſſel which had brought over Pollis, a delegate from Sparta, was fortunately at that time returning to Greece. Dion engaged Pollis to take the charge of the philoſopher, and land him ſafely in his native country; but Dionyſius diſcovered the deſign, and obtained a promiſe from Pollis, that he would either put him to death or ſell him as a ſlave upon the paſſage. Pollis accordingly ſold him in the iſland of Ægina; the inhabitants of which were then at war with the Athenians. Plato could not long remain unnoticed: Anicerris, a Cyrenaic philoſopher, who happened to be at that time in the iſland, diſcovered the ſtranger, and thought himſelf happy in an opportunity of ſhowing his reſpect for ſo illuſtrious a philoſopher: he purchaſed his freedom for 30 minæ, or 84 l. 10 s. Sterling money, and ſent him home to Athens. Repayment being afterwards offered to Anicerris by Plato's relations, he refuſed the money, ſaying, with that generous ſpirit which true philoſophy always inſpires, that he ſaw no reaſon why the relations of Plato ſhould engroſs to themſelves the honour of ſerving him.”

After a ſhort interval, Dionyſius repented of his ill-placed reſentment, and wrote to Plato, earneſtly requeſting him to repair his credit by returning to Syracuſe; to which Plato gave this high-ſpirited anſwer, that philoſophy would not allow him leiſure to think of Dionyſius. He was, however, prevailed upon by his friend Dion to accept of the tyrant's invitation to return to Syracuſe, and take upon him the education of Dionyſius the younger, who was heir apparent to the monarchy. He was received by Dionyſius the reigning ſovereign with every poſſible appearance of reſpect; but after ſeeing his friend baniſhed, and being himſelf kept as a priſoner at large in the palace, he was by the tyrant ſent back into his own country, with a promiſe that both he and Dion ſhould be recalled at the end of the war in which the Sicilians were then engaged. This promiſe was not fulfilled. The tyrant wiſhed for the return of Plato; but could not reſolve to recal Dion. At laſt, however, having probably promiſed that the philoſopher ſhould meet his friend at the court of Syracuſe, he prevailed upon Plato to viſit that capital a third time. When he arrived, the king met him in a magnificent chariot, and conducted him to his palace. The Sicilians too rejoiced in his return; for they hoped that the wiſdom of Plato would at length triumph over the tyrannical ſpirit of the prince. Dionyſius ſeemed wholly diveſted of his former reſentments, liſtened with apparent pleaſure to the philoſopher's doctrine, and among other expreſſions of regard, preſented him with eighty talents of gold. In the midſt of a numerous train of philoſophers, Plato now poſſeſſed the chief influence and authority in the court of Syracuſe. Whilſt Ariſtippus was enjoying himſelf in ſplendid luxury; whilſt Diogenes was freely indulging his acrimonious humour; and whilſt Æſchines was gratifying his thirſt after riches;—Plato ſupported the credit of philoſophy with an air of dignity, which his friends regarded as an indication of ſuperior wiſdom, but which his enemies imputed to pride. After all, it was not in the power of Plato to prevail upon Dionyſius to adopt his ſyſtem of policy, or to recal Dion from his exile. Mutual diſtruſt, after a ſhort interval, aroſe between the tyrant and the philoſopher; each ſuſpected the other of evil deſigns, and each endeavoured to conceal his ſuſpicion under the diſguiſe of reſpect. Dionyſius attempted to impoſe upon Plato by condeſcending attentions, and Plato to deceive Dionyſius by an appearance of confidence. At length, the philoſopher became ſo much diſſatisfied with his ſituation, that he earneſtly requeſted permiſſion to return to Greece, which was at laſt granted him, and he was ſent home loaded with rich preſents. On his way to Athens paſſing through Elis during the celebration of the Olympic games, he was preſent at this general aſſembly of the Greeks, and engaged univerſal attention.

From this narrative it appears, that if Plato viſited the courts of princes, it was chiefly from the hope of ſeeing his ideal plan of a republic realized; and that his talents and attainments rather qualified him to ſhine in the academy than in the council or the ſenate.

Plato, now reſtored to his country and his ſchool, devoted himſelf to ſcience, and ſpent the laſt years of a long life in the inſtruction of youth. Having enjoyed the advantage of an athletic conſtitution, and lived all his days temperately, he arrived at the 81ſt, or according to ſome writers the 79th, year of his age, and died, through the mere decay of nature, in the firſt year of the hundred and eighth Olympiad. He paſſed his whole life in a ſtate of celibacy, and therefore left no natural heirs, but transferred his effects by will to his friend Adiamantus. The grove and garden, which had been the ſcene of his philoſophical labours, at laſt afforded him a ſepulchre. Statues and altars were erected to his memory; the day of his birth long continued to be celebrated as a feſtival by his followers; and his portrait is to this day preſerved in gems: but the moſt laſting monuments of his genius are his writings, which have been tranſmitted, without material injury, to the preſent times.

The character of this philoſopher has always been high. Beſides the advantages of a noble birth, he had a large and comprehenſive underſtanding, a vaſt fund of wit and good taſte, great evenneſs and ſweetneſs of temper, all cultivated and refined by education and travel; ſo that it is no wonder if he was honoured by his countrymen, eſteemed by ſtrangers, and adored by his ſcholars. The ancients thought more highly of Plato than of all their philoſophers: they always called him the *Divine Plato*; and they ſeemed reſolved that his deſcent ſhould be more than human. "There are (ſays Apuleius) who aſſert Plato to have ſprung from a more ſublime conception; and that this mother Perictione, who was a very beautiful woman, was impregnated by Apollo in the ſhape of a ſpectre." Plutarch, Suidas, and others, affirm this to have been the common report at Athens. When he was an infant, his father Ariſto went to Hymettus, with his wife and child, to ſacrifice to the muſes; and while they were buſied in the divine rites a ſwarm of bees came and diſtilled their honey upon his lips. This, ſays Tully, was conſidered as a preſage of his future eloquence. Apuleius relates that Socrates, the night before Plato was recommended to him, dreamed that a young ſwan fled from Cupid's altar in the academy, and ſettled in his lap; thence ſoared to heaven, and delighted the gods with its muſic: and when Ariſto the next day preſented Plato to him, "Friends (ſays Socrates), this is the ſwan of Cupid's academy." The Greeks loved fables: they ſhow however in the preſent caſe, what exceeding reſpect was paid to the memory of Plato. Tully perfectly adored him; tells us, how he was juſtly called by Panætius the *divine*, the *moſt wiſe*, the *moſt ſacred*, the *Homer of philoſophers;* intitled him to Atticus, *Deus ille noſter:* thinks, that if Jupiter had ſpoken Greek, he would have ſpoken in Plato's language; and made him ſo implicitly his guide in wiſdom and philoſophy, as to declare that he had rather err with Plato than be right with any one elſe. But, panegyric aſide, Plato was certainly a very wonderful man, of a large and comprehenſive mind, an imagination infinitely fertile, and of a moſt flowing and copious eloquence. Nevertheleſs, the ſtrength and heat of fancy prevailing in his compoſition over judgment, he was too apt to ſoar beyond the limits of earthly things, to range in the imaginary regions of general and abſtracted ideas; and on which account, though there is always a greatneſs and ſublimity in his manner, he did not philoſophize ſo much according to truth and nature as Ariſtotle, though Cicero did not ſcruple to give him the preference.

The writings of Plato are all in the way of dialogue; where he ſeems to deliver nothing from himſelf, but every thing as the ſentiments and opinions of others, of Socrates chiefly, of Timæus, &c. He does not mention himſelf any where, except once in his Phædo, and another time in his Apology for Socrates. His ſtyle, as Ariſtotle obſerved, is betwixt proſe and verſe: on which account, ſome have not ſcrupled to rank him with the poets. There is a better reaſon for ſo doing than the elevation and grandeur of his ſtyle: his matter is oftentimes the offspring of imagination, inſtead of doctrines or truths deduced from nature. The firſt edition of Plato's works in Greek was put out by Aldus at Venice in 1513; but a Latin verſion of him by Marſilius Ficinus had been printed there in 1491. They were reprinted together at Lyons in 1588, and at Francfort in 1602. The famous printer Henry Stephens, in 1578, gave a moſt beautiful and correct edition of Plato's works at Paris, with a new Latin verſion by Serranus, in three volumes folio; and this deſervedly paſſes for the beſt edition of Plato: yet Serranus's verſion is very exceptionable, and in many reſpects, if not in all, inferior to that of Ficinus.

PLATONIC, ſomething that relates to Plato, his ſchool-philoſophy, opinions, or the like. Thus, Platonic love denotes a pure ſpiritual affection, for which Plato was a great advocate, ſubſiſting between the different ſexes, abſtracted from all carnal appetites, and regarding no other object but the mind and its beauties;

or it is even a ſincere diſintereſted friendſhip ſubſiſting between perſons of the ſame ſex, abſtracted from any ſelfiſh views, and regarding no other object than the perſon, if any ſuch love or friendſhip has aught of a foundation in nature.

Platonic Year, or the *Great Year*, is a period of time determined by the revolution of the equinoxes, or the ſpace wherein the ſtars, and conſtellations return to their former places in reſpect of the equinoxes. The Platonic year, according to Tycho Brahe, is 25816, according to Ricciolus 25920, and according to Caſſini 24800 years.

This period once accompliſhed, it was an opinion among the ancients that the world was to begin anew, and the ſame ſeries of things to turn over again.

PLATONISM, the philoſophy of Plato, which was divided into three branches, *theology*, *phyſics*, and *mathematics*. Under *theology* was comprehended metaphyſics and ethics, or that which in modern language is called *moral* philoſophy. Plato wrote likewiſe on *dialectics*, but with ſuch inferiority to his pupil Ariſtotle, that his works in that department of ſcience are ſeldom mentioned.

The ancient philoſophers always began their theological ſyſtems with ſome diſquiſition on the nature of the gods, and the formation of the world; and it was a fundamental doctrine with them, that *from nothing nothing can proceed*. We are not to ſuppoſe that this general axiom implied nothing more than that for every effect there muſt be a cauſe; for this is a propoſition which no man will controvert who underſtands the terms in which it is expreſſed: but the ancients believed that a proper creation is impoſſible even to Omnipotence, and that to the production of any thing a *material* is not leſs *neceſſary* than an *efficient* cauſe, (ſee Metaphysics, n° 264, 304.) That with reſpect to this important queſtion, Plato agreed with his predeceſſors and contemporaries, appears evident to us from the whole tenor of his *Timæus*. We agree with Dr Enfield § in thinking, that in this dialogue which comprehends his whole doctrine on the ſubject of the formation of the univerſe, matter is ſo manifeſtly ſpoken of as eternally co-exiſting with God that this part of his doctrine could not have been miſtaken by ſo many learned and able writers, had they not been ſeduced by the deſire of eſtabliſhing a coincidence of doctrine between the writings of Plato and Moſes. It is certain that neither Cicero ‡, nor Apuleius ||, nor Alcinous †, nor even the later commentator Chalcidius, underſtood their maſter in any other ſenſe than as admitting two primary and incorruptible principles, God and matter; to which we ſhall afterwards ſee reaſon to add a third, namely ideas. The paſſages quoted by thoſe who maintain the contrary opinion are by no means ſufficient for their purpoſe. Plato, it is true, in his Timæus, calls God the *parent of the univerſe*, and in his Sophiſta ſpeaks of him as "forming animate and inanimate beings, which did not before exiſt:" but theſe expreſſions do not neceſſarily imply that this offſpring of Deity was produced from nothing, or that no prior matter exiſted from which theſe new beings were formed. Through the whole dialogue of the Timæus, Plato ſuppoſes two eternal and independent cauſes of all things; one, that by which all things are made, which is God; the other, that from which all things are made, which is matter. He diſtinguiſhes between God, matter, and the univerſe, and ſuppoſes the Architect of the world to have formed it out of a maſs of pre-exiſtent matter. Matter, according to Plato, is an eternal and infinite principle. His doctrine on this head is thus explained by Cicero *. "Matter, from which all things are produced and formed, is a ſubſtance without form or quality, but capable of receiving all forms, and undergoing every kind of change; in which, however, it never ſuffers annihilation, but merely a ſolution of its parts, which are in their nature infinitely diviſible, and move in portions of ſpace which are alſo infinitely diviſible. When that principle which we call quality is moved, and acts upon matter, it undergoes an entire change, and thoſe forms are produced, from which ariſes the diverſified and coherent ſyſtem of the univerſe." This doctrine Plato unfolds at large in his Timæus, and particularly inſiſts upon the notion, that matter has originally no form, but is capable of receiving any. He calls it the mother and receptacle of forms, by the union of which, with matter the univerſe becomes perceptible to the ſenſes; and maintains, that the viſible world owes its forms to the energy of the divine intellectual nature.

Our author is ſupported in drawing this inference by the teſtimony of Diogenes, Laertius, who ſurely underſtood the language and dogmas of Plato better than the moſt accompliſhed modern ſcholar can pretend to do; yet a learned writer ‡ has lately expreſſed great ſurpriſe that any one ſhould conſider matter as having been, in Plato's opinion, uncreated; and he boldly affirms, that Laertius, inſtead of aſſerting that ſpirit and matter were the principles of all things, ought to have ſaid that God alone, in Plato's eſtimation, was their original.—To prove this, he gives from the Timæus a quotation, in which the founder of the Academy declares that God *framed* heaven and earth, and the inferior deities; and that as he *faſhioned*, ſo he pervades all nature. He obſerves, that Cicero denominates the god of Plato the *maker*, and the god of Ariſtotle only the *governor*, of the world. And, to ſatisfy thoſe who may demand a particular proof of Plato's having taught a real creation, he affirms that his writings abound with declarations on the ſubject, of which the meaning cannot be miſapprehended.

Theology of Plato.

"With this purpoſe (ſays he) Plato denominates at one time the principles or ſubſtance of all things, Τωνοματα θεου Δημιουργον, the productions of the efficient Deity, and at others enters more particularly into the queſtion. Thus, he obſerves, that many perſons are ignorant of the nature and power of mind or intellect, 'as having exiſted at the beginning antecedent to all bodies.' Of this mind he obſerves that it is without exception Παντων πρεσϐυτατη, *of all things the moſt ancient*; and he ſubjoins, in order to remove all doubt of his purpoſe, that it is alſo Αρχη κινησεως, *the cauſe or principle of motion*."

With all poſſible reſpect for Dr Ogilvie, of whoſe piety and erudition we are thoroughly convinced, we muſt take the liberty to ſay, that to us the declarations of Plato on this ſubject appear much leſs preciſe and explicit than they appear to him; and that the inference which he would draw from the *words* of Cicero ſeems now to flow neceſſarily from the *ſenſe* of thoſe words. That Plato believed God to have *framed* the heaven and the earth, and to have *faſhioned* all nature, is a poſition which, as far as we know, has never been controverted; but between *framing* or *faſhioning* the chaos or ὑλη πρωτη, and calling the univerſe into exiſtence from non-

§ Hiſt. of Phil.

‡ Ac. Qu. l. i. c. 6.

|| Lib. 1.

† C. 12.

* Ac. Qu. l. i. c. 8.

‡ Dr Ogilvie.

entity, there is an infinite and an obvious difference. The diſtinction made by Cicero between the God of Plato and the God of Ariſtotle is a juſt diſtinction, but it will not bear the ſuperſtructure which the learned Doctor builds upon it. Ariſtotle maintained the eternity of the world in its preſent form. Plato certainly taught that the firſt matter was in time reduced from a chaotic ſtate into *form* by the power of the Demiurgus; but we have ſeen nothing in his writings which explicitly declares his belief that the *firſt matter* was itſelf *created*.

The learned Cudworth, who wiſhed like Dr Ogilvie, to find a coincidence of doctrine between the theology of Plato and that of the Goſpel, ſtrained all his faculties to prove that his favourite philoſopher taught a proper creation; but he laboured in vain. He gives a number of quotations in ſupport of his poſition; of which we ſhall here inſert only theſe two upon which Dr Ogilvie ſeems to lay the greateſt ſtreſs. Plato, ſays the author of the Intellectual Syſtem, calls the one God (A) ὃς γην ουρανον και θεους, και παντα τα εν ουρανω και τα εν ἅδου, και ὑπο γης ἁπαντα εργασεται—*He that makes earth, and heaven, and the gods, and doth all things both in heaven, and hell, and under the earth.* And, again, "he by whoſe efficiency the things of the world (ὑστερον εγενετο, προτερον ουκ οντα) *were afterwards made when they were not before**." Both Cudworth and Ogilvie think this laſt ſentence an explicit declaration of Plato's belief in the creative power of God: but that they are miſtaken has been evinced by Moſheim with a force of argument which will admit of no reply. In that part of *the Sophiſt* from which the quotation is taken, Plato conſiders the δυναμιν ποιητικην, of which he is treating, as belonging both to God and to man; and he defines it in general to be "a certain power which is the cauſe that things may afterwards be which were not before." Cudworth wiſhes to confine this definition to the divine power; and adds from himſelf to the text which he quotes the following words, which are not in Plato, OR FROM AN ANTECEDENT NON-EXISTENCE BROUGHT FORTH INTO BEING! That the incomparable author intended to deceive his reader, we are far from imagining: his zeal for Platoniſm had deceived himſelf. Plato's definition comprehends the δυναμιν ποιητικην† as well of man as of God; and therefore cannot infer a creative power any where, unleſs the father of the academy was ſo very abſurd as to ſuppoſe human artiſts the creators of thoſe machines which they have invented and made! Moſheim thinks that Cudworth was miſled by too implicit a confidence in *Ficinus*; and it is not impoſſible that Dr Ogilvie may have been ſwayed by the authority, great indeed, of the author of the Intellectual Syſtem.

That intellect exiſted antecedent to all bodies is indeed a Platonic dogma, from which Dr Ogilvie, after Cudworth, wiſhes to infer that the doctrine of the creation was taught in the academy; but Dr Ogilvie knows and no man knew better than Cudworth, that Plato, with every other Greek philoſopher, diſtinguiſhed between *body* and *matter*; and that though he held the priority of intellect to the former, it by no means follows that he believed it to have exiſted antecedent to the latter. That he believed *mind*, or rather *ſoul* (for he diſtinguiſhes between the two), to be the cauſe or principle of motion cannot be denied; but we are not therefore authoriſed to conclude that he likewiſe believed it to be the cauſe of the exiſtence of matter. That he believed mind to be the moſt ancient of *all things*, taking the word *things* in the moſt abſolute ſenſe, cannot be true, ſince by Dr Ogilvie's own acknowledgment he held the exiſtence and eternity of *ideas*, not to add that he believed το ἓν or τ'αγαθον—the firſt hypoſtaſis in his trinity, to be ſuperior to mind and prior to it though not in time, yet in the order of nature. When therefore he calls mind the moſt ancient of *all things*, he muſt be ſuppoſed to mean only that it is more ancient, than *all bodies* and inferior ſouls. It is no reflection on the character of Plato that he could not, by the efforts of his own reaſon, acquire any notion of a proper creation; ſince we, who have the advantage of his writings, and of writings infinitely more valuable, to inſtruct us, find it extremely difficult, if not impoſſible, to conceive how any thing can begin to be. We believe the fact on the authority of revelation; but ſhould certainly have never agitated ſuch a queſtion, had it not been ſtated to us by writers inſpired with celeſtial wiſdom.

In the Platonic coſmogony we cannot therefore doubt but that the eternity of the ὑλη πρωτη was taken for granted. Whether it was an eternal and neceſſary emanation from an eternal mind, is not perhaps quite ſo evident, though our own opinion is, that it was believed to be ſelf-exiſtent. But be this as it may, which is not worth diſputing, one thing is certain, that Plato did not believe it to have a ſingle form or quality which it did not receive either from the *Demiurgus* or the *Pſyche*—the ſecond or third perſon of his trinity. Except Ariſtotle, all the Greek philoſophers, who were not materialiſts, held nearly the ſame opinions reſpecting the origin of the world; ſo that in examining their ſyſtems we ſhall be greatly miſled if we underſtand the terms *incorporeal* and *immaterial* as at all ſynonymous. It was alſo a doctrine of Plato, that there is in matter a neceſſary but blind and refractory force; and that hence ariſes a propenſity in matter to diſorder and deformity, which is the cauſe of all the imperfection which appears in the works of God, and the origin of evil. On this ſubject Plato writes with wonderful obſcurity: but, as far as we are able to trace his conceptions, he appears to have thought, that matter, from its nature, reſiſts the will of the Supreme Artificer, ſo that he cannot perfectly execute his deſigns; and that this is the cauſe of the

* Sophiſta, p. 168.

† Moſch. ed. Cud. Syſt. Intel cap. 4. § 23. n. 11.

(A) Moſheim affirms that this quotation is nowhere to be found in the writings of Plato. He therefore at firſt ſuſpected that the learned author, in looking haſtily over Plato's 10th book *De Legibus*, had transferred to God what is there ſaid of the *anima mundi*, leading by its own motions every thing in the heaven, the earth, and the ſea, and that he had added ſomething of his own. He dropped that opinion, however, when he found Plato, in the 10th book of his Republic, declaring it to be as "eaſy for God to produce the ſun moon and ſtars, and earth, &c. from himſelf, as it is for us to produce the image of ourſelves, and whatever elſe we pleaſe, only by interpoſing a looking-glaſs." In all tthis power, however, there is nothing ſimilar to that of creation.

the mixture of good and evil which is found in the material world.

Plato, however, was no materialiſt. He taught, that there is an intelligent cauſe, which is the origin of all ſpiritual being, and the former of the material world. The nature of this great being he pronounced it difficult to diſcover, and when diſcovered impoſſible to divulge. The exiſtence of God he inferred from the marks of intelligence, which appear in the form and arrangement of bodies in the viſible world: and from the unity of the material ſyſtem he concluded, that the mind by which it was formed muſt be one. God, according to Plato, is the ſupreme intelligence, incorporeal, without beginning, end, or change, and capable of being perceived only by the mind. He certainly diſtinguiſhed the Deity not only from body, and whatever has corporeal qualities, but from matter itſelf, from which all things are made. He alſo aſcribed to him all thoſe qualities which modern philoſophers aſcribe to immaterial ſubſtance; and conceived him to be in his nature ſimple, uncircumſcribed in ſpace, the author of all regulated motion, and, in fine, poſſeſſed of intelligence in the higheſt perfection.

His notions of God are indeed exceedingly refined, and ſuch as it is difficult to ſuppoſe that he could ever have acquired but from ſome obſcure remains of primeval tradition, gleaned perhaps from the prieſts of Egypt or from the philoſophers of the Eaſt. In the Divine Nature he certainly believed that there are two, and probably that there are three, *hypoſtaſes*, whom he called το ον and το εν, νους and ψυχη. The firſt be conſidered as ſelf-exiſtent, and elevated far above all mind and all knowledge; calling him, by way of eminence, *the being*, or *the one*. The only attribute which he acknowledged in this perſon was goodneſs; and therefore he frequently ſtyles him the το αγαθον—*the good*, or *eſſential goodneſs*. The ſecond he conſidered as mind, the *wiſdom* or *reaſon* of the firſt, and the *maker of the world;* and therefore he ſtyles him νους, λογος, and δημιουργος. The third he always ſpeaks of as the *ſoul of the world;* and hence calls him ψυχη, or ψυχη του κοσμου. He taught that the *ſecond* is a neceſſary emanation from the *firſt*, and the *third* from the *ſecond*, or perhaps from the *firſt* and *ſecond*.

Some have indeed pretended, that the *Trinity*, which is commonly called *Platonic*, was a fiction of the later Platoniſts, unknown to the founder of the ſchool; but any perſon who ſhall take the trouble to ſtudy the writings of Plato, will find abundant evidence that he really aſſerted a triad of divine hypoſtaſes, all concerned in the formation and government of the world, Thus in his 10th book of Laws where he undertakes to prove the exiſtence of a Deity in oppoſition to atheiſts, he aſcends no higher in the demonſtration than to the ψυχη or mundane ſoul, which he held to be the immediate and proper cauſe of all the motion that is in the world. But in other parts of his writings he frequently aſſerts, as ſuperior to the ſelf-moving principle, an immoveable νους or intellect, which was properly the *demiurgus* or framer of the world; and above this *hypoſtaſis* one moſt ſimple and abſolutely perfect being, who is conſidered in his *Theology* as αυτοθεος, the *original deity*, in contradiſtinction from the others, who are only θεοι εκ θεου. Theſe doctrines are to be gathered from his works at large, particularly from the *Timæus*, *Philebus*, *Sophiſta*, and *Epinomis:* but there is a paſſage in his ſecond epiſtle to Dionyſius, apparently written in anſwer to a letter in which that monarch had required him to give a more explicit account than he had formerly done of the nature of God, in which the doctrine of a Trinity ſeems to be directly aſſerted. "After having ſaid that he meant to wrap up his meaning in ſuch obſcurity, as that an adept only ſhould fully comprehend it, he adds expreſſions to the following import: 'The Lord of Nature is ſurrounded on all ſides by his works: whatever is, exiſts by his permiſſion: he is the fountain and ſource of excellence: around the ſecond perſon are placed things of the ſecond order; and around the third thoſe of the third degree (B)." Of this obſcure paſſage a very ſatisfactory explanation is given in Dr Ogilvie's *Theology of Plato*, to which the narrow limits preſcribed to ſuch articles as this compel us to refer the reader. We ſhall only ſay, that the account which we have given of the Platonic Trinity is ably ſupported by the Doctor.

In treating of the eternal emanation of the ſecond and third Hypoſtaſes from the firſt, the philoſophers of the academy compare them to light and heat proceeding from the ſun. Plato himſelf, as quoted by Dr Cudworth, illuſtrates his doctrine by the ſame compariſon. For "επ'αγαθον, or the firſt hypoſtaſis, is in the intellectual world the ſame (he ſays) to intellect and intelligibles that the ſun is in the corporeal world to viſion and viſibles; for as the ſun is not viſion itſelf but the cauſe of viſion, and as that light by which we ſee is not the ſun but only a thing like the ſun; ſo neither is the Supreme or Higheſt Good properly knowledge, but the cauſe of knowledge; nor is intellect, conſidered as ſuch, the beſt and moſt perfect being, but only a being having the form of perfection." Again, "as the ſun cauſes other things not only to become viſible but alſo to be generated; ſo the Supreme Good gives to things not only their capability of being known, but alſo their very eſſences by which they ſubſiſt; for this fountain of the Deity, this higheſt good, is not itſelf properly eſſence, but above eſſence, tranſcending it in reſpect both of dignity and of power."

The reſemblance which this trinity of Plato bears to that revealed in the goſpel muſt be obſerved by every attentive reader; but the two doctrines are likewiſe in ſome reſpects exceedingly diſſimilar. The third hypoſtaſis in the Platonic ſyſtem appears in no point of view co-ordinate with the firſt or ſecond. Indeed the firſt is elevated far above the ſecond, and the third ſunk ſtill farther beneath it, being conſidered as a mere ſoul immerſed in matter, and forming with the corporeal world, to which it is united, one compound animal. Nay, it does not appear perfectly clear, that Plato conſidered his ψυχη του κοσμου as a pure ſpirit, or as having ſubſiſted from eternity as a diſtinct *Hypoſtaſis*. "This governing ſpirit, of whom the earth, properly ſo called, is the body

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(B) "Περι των παντων βασιλεα, παντ'εστι, και Εκεινου ενεκα παντα. Εκεινος αιτια παντων των καλων. Δευτερον δε περι τα δευτερα, και τριτον περι τα τριτα." Oper. p. 1269.

body, conſiſted, according to our author's philoſophy, of the ſame and the other; that is, of the firſt matter, and of pure intelligence, framed to actuate the machinery of nature. The Supreme Being placed him in the middle of the earth; which, in the vivid idea of Plato, ſeemed itſelf to live, in conſequence of an influence that was felt in every part of it. From this ſeat his power is repreſented as being extended on all ſides to the utmoſt limit of the heavens; conferring life, and preſerving harmony in the various and complicated parts of the univerſe. Upon this being God is ſaid to have looked with peculiar complacency after having formed him as an image of himſelf, and to have given beauty and perfect proportion to the manſion which he was deſtined to occupy. According to the doctrine of Timæus, the Supreme being ſtruck out from this original mind innumerable ſpirits of inferior order, endowed with principles of reaſon; and he committed to divinities of ſecondary rank the taſk of inveſting theſe in material forms, and of diſperſing them as inhabitants of the ſun, moon, and other celeſtial bodies. He taught alſo that at death the human ſoul is reunited to the ψυχη του κοσμου, as to the ſource from which it originally came."

Such is the third perſon of the Platonic triad, as we find his nature and attributes very accurately ſtated by Dr Ogilvie; and the Chriſtian philoſopher, who has no particular ſyſtem to ſupport, will not require another proof that the triad of Plato differs exceedingly from the Trinity of the Scriptures. Indeed the third hypoſtaſis in this triad has ſo much the appearance of all that the ancients could mean by that which we call a *creature*, that the learned Cudworth, who wiſhed, it is difficult to conceive for what reaſon, to find the ſublimeſt myſtery of the Chriſtian faith explicitly taught in the writings of a pagan philoſopher, was forced to ſuppoſe that Plato held a double ψυχη or ſoul, one εγκοσμιον incorporated with the material world, and the other υπερκοσμιον or *ſupramundane*, which is not the ſoul but the governor of the univerſe. We call this a mere hypotheſis; for though the author diſplays vaſt erudition, and adduces many quotations in which this double *pſyche* is plainly mentioned, yet all thoſe quotations are taken from Platoniſts who lived after the propagation of the goſpel, and who, calling themſelves *ecclectics*, freely ſtole from every ſect ſuch dogmas as they could incorporate with their own ſyſtem, and then attributed thoſe dogmas to their maſter. In the writings of Plato himſelf, there is not ſo much as an alluſion to this ſupramundane *pſyche* *; and it is for this reaſon (the ψυχη, of which he treats being ſo very inferior to the δημιουργος and ταγαθον) that we have expreſſed with heſitation his belief of *three* hypoſtaſes in the divine nature. Yet that he did admit ſo many, ſeems more than probable both from the paſſage illuſtrated by Dr Ogilvie and from the attempt of Plotinus, one of his followers, to demonſtrate that the number can be neither greater nor leſs. That his doctrine on this ſubject ſhould be inaccurate and erroneous, can excite no wonder; whilſt it muſt be confeſſed to have ſuch a reſemblance to the truth, and to be ſo incapable of being proved by reaſoning from effects to cauſes, that we could not doubt of his having inherited it by tradition, even though we had not complete evidence that ſomething very ſimilar to it was taught long before him, not only by Pythagoras and Parmenides, but by the philoſophers of the eaſt.

We have ſaid that the Demiurgus was the maker of the world from the firſt matter which had exiſted from eternity; but in Plato's coſmogony there is another principle more myſterious, if poſſible, than any thing which we have yet mentioned. This is his intellectual ſyſtem of *ideas*, which it is not eaſy to collect from his writings, whether he conſidered as *independent* exiſtences, or only as archetypal *forms*, which had ſubſiſted from eternity in the λογος or divine intellect. On this ſubject he writes with ſuch exceeding obſcurity, that men of the firſt eminence, both among the ancients and the moderns, have differed about his real meaning. Some have ſuppoſed, that by *ideas* he meant real beings ſubſiſting from eternity, independent of all minds, and ſeparate from all matter; and that of theſe ideas he conceived ſome to be living and others to be without life. In this manner his doctrine is interpreted by Tertulian * among the ancients, and by the celebrated Brucker † among the moderns; and not by them only, but by many others equally learned, candid and acute. Cudworth, on the other hand, with his annotator Moſheim, contend, that by his ideal world Plato meant nothing more than that there exiſted from eternity in the λογος or mind of God a notion or conception of every thing which was in time to be made. This is certainly much more probable in itſelf, than that a man of enlarged underſtanding ſhould have ſuppoſed that there are ſomewhere in extramundane ſpace real living incorporeal beings eating and drinking, which are the *ideas* of all the animals which ever have been or ever will be eating and drinking in this world. Yet Moſheim candidly acknowledges, that if the controverſy were to be decided by the votes of the learned, he is doubtful whether it would be given for or againſt him; and Cudworth, though he pleads the cauſe of his maſter with much ingenuity, owns, that on this ſubject his language cannot be vindicated. This indeed is moſt true; for Plato contends, that his ideas are not only the objects of ſcience, but alſo the proper or phyſical cauſes of all things here below; that the *idea* of ſimilitude is the *cauſe* of the reſemblance between two globes; and the *idea* of diſſimilitude the cauſe that a globe does not reſemble a pyramid: he likewiſe calls them ουσιας, *eſſences* or *ſubſtances*, and many of his followers have pronounced them to be *animals*.

Theſe wonderful expreſſions incline us to adopt with ſome heſitation the opinion ſtated by Dr Enfield. This hiſtorian of philoſophy having obſerved, that ſome of the admirers of Plato contend, that by ideas exiſting in the reaſon of God, nothing more is meant than conceptions formed in the Divine mind, controverts this opinion with much effect. "By ideas, Plato (ſays he) appears to have meant ſomething much more myſterious; namely, patterns or archetypes ſubſiſting by themſelves, as real beings, οντος οντα in the Divine reaſon, as in their original and eternal region, and iſſuing thence to give form to ſenſible things, and to become objects of contemplation and ſcience to rational beings. It is the doctrine of the Timæus, that ὁ λογισμος τȣ Θεȣ, the reaſon of God, comprehends exemplars of all things, and that this reaſon is one of the primary cauſes of things. Plutarch ſays, that Plato ſuppoſes three principles, God, Matter, and Idea. Juſtin Martyr, Pſeudo-Origen, and others, aſſert the ſame thing.

"That this is the true Platonic doctrine of ideas will appear probable, if we attend to the manner in which Plato framed his ſyſtem of opinions concerning the origin of things. 'Having been from his youth (ſays Ariſtotle) converſant with Cratylus, a diſciple of Heraclitus, and inſtructed in the doctrine of that ſchool, that all ſenſible things are variable, and cannot be proper objects of ſcience, he reaſonably concluded, that if there be any ſuch thing as ſcience, there muſt exiſt, beſides ſenſible objects, certain permanent natures, perceptible only by the intellect.' Such natures, divine in their origin, and eternal and immutable in their exiſtence, he admitted into his ſyſtem, and called them *ideas*. Viſible things were regarded by Plato as fleeting ſhades, and ideas as the only permanent ſubſtances. Theſe he conceived to be the proper objects of ſcience to a mind raiſed by divine contemplation above the perpetually varying ſcenes of the material world."

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* Moſch. ed. Cud. Syſt Intel. c. 4. § 36. n. 43.

* Lib. de Anima.

† Hiſtor. Doctrin. de Idæis,

It was a fundamental doctrine in the ſyſtem of Plato, that the Deity formed the material world after a perfect model, conſiſting of thoſe ideas which had eternally ſubſiſted in his own reaſon; and yet, with ſome appearance of contradiction, he calls this model "*ſelf-*exiſtent, indiviſible, and eternally *generated*." Nay, he talks of it as being intelligent as well as eternal, and wholly different from the tranſcripts, which are ſubjected to our inſpection. There is ſo much myſtery, confuſion, and apparent abſurdity, in the whole of this ſyſtem, as it has come down to us, that we muſt ſuppoſe the friends of Plato to have been intruſted with a key to his eſoteric doctrines, which has long been loſt, otherwiſe it would be difficult to conceive how that philoſopher could have had ſo many admirers.

With almoſt every ancient theiſt of Greece the founder of the academy believed in an order of beings called *dæmons*, which were ſuperior to the ſouls of men, and ſtruck off by the Demiurgus from the ſoul of the world. Of theſe the reader will find ſome account elſewhere: (See DÆMON and POLYTHEISM). We mention them at preſent becauſe they make an important appearance in Plato's ſyſtem of phyſics, which was built upon them and upon the doctrine which has been ſtated concerning God, matter, and ideas. He taught, that the viſible world was formed by the Supreme Architect, uniting eternal and immutable ideas to the firſt matter; that the univerſe is one animated being*, including within its limits all animated natures; that in the formation of the viſible and tangible world, fire and earth were firſt formed, and were afterwards united by means of air and water; that from perfect parts one perfect whole was produced, of a ſpherical figure, as moſt beautiful in itſelf, and beſt ſuited to contain all other figures†; that the elementary parts of the world are of regular geometrical forms, the particles of earth being cubical, thoſe of fire pyramidical, thoſe of air in the form of an octohedron, and thoſe of water in that of an icoſohedron; that theſe are adjuſted in number, meaſure, and power, in perfect conformity to the geometrical laws of proportion; that the ſoul which pervades this ſphere is the cauſe of its revolution round this centre; and, laſtly, that the world will remain for ever, but that by the action of its animating principle, it accompliſhes certain periods, within which every thing returns to its ancient place and ſtate. This periodical revolution of nature is called the *Platonic* or *great year*. See the preceding article.

The metaphyſical doctrines of Plato, which treat of the human ſoul, and the principles of his ſyſtem of ethics, have been detailed in other articles (See METAPHYSICS, Part III. chap. iv.; and MORAL *Philoſophy*, nº 6.): but it is worthy of obſervation in this place, that preparatory to the ſtudy of all philoſophy, he required from his diſciples a knowledge of the elements of mathematics. In his Republic, he makes Glaucus, one of the ſpeakers, recommend them for their uſefulneſs in human life. "Arithmetic for accounts and diſtributions; geometry for encampments and menſurations; muſic for ſolemn feſtivals in honour of the gods; and aſtronomy for agriculture, for navigation, and the like. Socrates, on his part, denies not the truth of all this, but ſtill inſinuates that they were capable of anſwering an end more ſublime. 'You are pleaſant (ſays he) in your ſeeming to fear the multitude, leſt you ſhould be thought to enjoin certain ſciences that are uſeleſs. 'Tis indeed no contemptible matter, though a difficult one, to believe, that through theſe particular ſciences the ſoul has an organ purified and enlightened, which is deſtroyed and blinded by ſtudies of other kinds; an organ better worth ſaving than a thouſand eyes, inaſmuch as *truth* becomes viſible through *this alone*."

"Concerning policy, Plato has written at large in his Republic and in his Dialogue on Laws. He was ſo much enamoured with his own conceptions on this ſubject, that it was chiefly the hope of having an opportunity to realiſe his plan of a republic which induced him to viſit the court of Dionyſius. But they who are converſant with mankind, and capable of calmly inveſtigation the ſprings of human actions, will eaſily perceive that his projects were chimerical, and could only have originated in a mind replete with philoſophical enthuſiaſm. Of this nothing can be a clearer proof than the deſign of admitting in his republic a community of women, in order to give reaſon an entire controul over deſire. The main object of his political inſtitutions appears to have been, the ſubjugations of the paſſions and appetites by means of the abſtract contemplation of ideas. A ſyſtem of policy, raiſed upon ſuch fanciful grounds, cannot merit a more diſtinct conſideration."

Such is genuine Platoniſm as it was taught in the old academy by the founder of the ſchool and his immediate followers; but when Arceſilaus was placed at the head of the academics, great innovations were introduced both into their doctrines and into their mode of teaching (See ARCESILAUS). This man was therefore conſidered as the founder of what was afterwards called the *middle* academy. Being a profeſſed ſceptic, he carried his maxim of uncertainty to ſuch a height, as to alarm the general body of philoſophers, offend the governors of the ſtate, and bring juſt odium upon the very name of the academy. At length, *Carneades*, one of the diſciples of this ſchool, relinquiſhing ſome of the more obnoxious tenets of Arceſilaus, founded what has been called the *new* academy with very little improvement on the principles of the middle. See CARNEADES.

Under one or other of theſe forms Platoniſm found its way into the Roman republic. Cicero was a Platoniſt, and one of the greateſt ornaments of the ſchool. A ſchool of Platoniſts was likewiſe founded in Alexandria in the ſecond century of the Chriſtian era; but their doctrines differed in many particulars from thoſe taught in the three academies. They profeſſed to ſeek truth wherever they could find it, and to collect their dogmas from every ſchool. They endeavoured to bend ſome of the principles of Plato into a conformity with the doctrines of the goſpel; and they incorporated with the whole many of the maxims of Ariſtotle and Zeno, and not a few of the fictions of the eaſt. Their ſyſtem was therefore extremely heterogeneous, and ſeldom ſo rational as that of the philoſopher after whoſe name they were called, and of whoſe doctrines we have given ſo copious a detail. See AMMONIUS, ECCLECTICS, and PLOTINUS.

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* Tim.

† Ibid.

PLAUTUS (Marcus Accius), a comic writer of ancient Rome, born at Umbria, a province of Italy. His proper name was *Marcus Accius*, and he is ſuppoſed to have acquired the ſurname of *Plautus* from having ſplay feet. His parentage appears to have been mean; ſo that ſome have thought he was the ſon of a ſlave. Aulus Gellius ſays that Plautus was diſtinguiſhed for his poetry on the theatre, and Cato for his eloquence in the Forum, at the ſame time; and obſerves elſewhere from Varro, that he was ſo well paid for his plays as to double his ſtock in trading, in which he loſt all he gained by the muſes. He is ſaid to have been reduced to work at a mill for his ſubſiſtence; but Varro adds, that his wit was his beſt ſupport, as he compoſed three of his plays during this drudgery. He died in the firſt year of the elder Cato's cenſorſhip, about the year of Rome 569, and 184 B. C. We have 20 of his plays extant, though not all of them entire. Five of them, comedies, have been elegantly tranſlated into Engliſh by Mr B. Thornton, and publiſhed in 2 vols 8vo, 1767.

PLAYS. See PLAY-houſe.

PLAY-houſe. See THEATRE, AMPHITHEATRE, &c. The moſt ancient Engliſh play-houſes were the Curtain in Shoreditch and the Theatre. In the time of Shakeſpeare, who commenced a dramatic writer in 1592, there was no leſs than ten theatres open. Four of theſe were private houſes, viz. that in Blackfriars, the Cockpit or Phœnix in Drury-Lane, a theatre in Whitefriars, and one in Saliſbury court. The other ſix were called public theatres, viz. the Globe, the Swan, the Roſe, and the Hope, on the Bank-ſide; the Red Bull, at the upper end of St John's ſtreet, and the Fortune in White-croſs Street. The two laſt were chiefly frequented by citizens. Mr Malone gives us a pretty copious account of theſe play-houſes, in a ſupplement to his laſt edition of Shakeſpeare, which we ſhall here inſert.

"Moſt, if not all (ſays he) of Shakeſpeare's plays were performed either at the Globe or at the Theatre in Blackfriars. It appears that they both belonged to the ſame company of comedians, viz. his majeſty's ſervants, which title they aſſumed, after a licence had been granted to them by King James in 1603, having before that time been called the ſervants of the lord chamberlain.

"The theatre in Blackfriars was a private houſe; but the peculiar and diſtinguiſhing marks of a private play houſe it is not eaſy to aſcertain. It was very ſmall, and plays were there uſually repreſented by candle light. The Globe, ſituated on the ſouthern ſide of the river Thames, was a hexagonal building, partly open to the weather, partly covered with reeds. It was a public theatre, and of conſiderable ſize, and there they always acted by day-light. On the roof of the Globe, and the other public theatres, a pole was erected, to which a flag was affixed. Theſe flags were probably diſplayed only during the hours of exhibition, and it ſhould ſeem from a paſſage in one of the old comedies that they were taken down during Lent, in which ſeaſon no plays were preſented. The Globe, though hexagonal at the outſide, was probably a rotunda within, and perhaps had its name from its circular form. It might, however, have been denominated only from its ſign, which was a figure of Hercules ſupporting the Globe. This theatre was burnt down in 1613, but it was rebuilt in the following year, and decorated with more ornament than had been originally beſtowed upon it. The exhibitions at the Globe ſeem to have been calculated chiefly for the lower claſs of people; thoſe at Blackfriars for a more ſelect and judicious audience.

"A writer informs us, that one of theſe theatres was a winter and the other a ſummer houſe. As the Globe was partly expoſed to the weather, and they acted there uſually by day-light, it was probably the ſummer theatre. The exhibitions here ſeem to have been more frequent than at Blackfriars, at leaſt till the year 1604 or 1605, when the Bank-ſide appears to have become leſs faſhionable and leſs frequented than it formerly had been. Many of our ancient dramatic pieces were performed in the yards of carriers inns; in which, in the beginning of Queen Elizabeth's reign, the comedians, who then firſt united themſelves in companies, erected an occaſional ſtage. The form of theſe temporary play-houſes ſeems to be preſerved in our modern theatre. The galleries are in both ranged over each other on three ſides of the building. The ſmall rooms under the loweſt of theſe galleries anſwer to our preſent boxes; and it is obſervable that theſe, even in theatres which were built in a ſubſequent period expreſsly for dramatic exhibitions, ſtill retained their old name, and are frequently called rooms by our ancient writers. The yard bears a ſufficient reſemblance to the pit, as at preſent in uſe. We may ſuppoſe the ſtage to have been raiſed in this area, on the fourth ſide, with its back to the gateway of the inn, at which the money for admiſſion was taken. Hence, in the middle of the Globe, and I ſuppoſe of the other public theatres, in the time of Shakeſpeare, there was an open yard or area, where the common people ſtood to ſee the exhibition; from which circumſtance they are called by our author groundlings, and by Ben Johnſon 'the underſtanding gentlemen of the ground.'

"In the ancient play-houſes there appears to have been a private box, of which it is not eaſy to aſcertain the ſituation. It ſeems to have been placed at the ſide of the ſtage towards the rear, and to have been at a lower price: in this ſome people ſat, either from economy or ſingularity. The galleries, or ſcaffolds as they are ſometimes called, and that part of the houſe which in private theatres was named the pit, ſeem to have been at the ſame price; and probably in houſes of reputation, ſuch as the Globe, and that in Blackfriars, the price of admiſſion into thoſe parts of the theatre was 6 d. while in ſome meaner play-houſes it was only 1 d. in others only 2 d. The price of admiſſion into the beſt rooms or boxes was, I believe, in our author's time, 1 s.; though afterwards it appears to have riſen to 2 s. and half a crown.

" From ſeveral paſſages in our old plays, we learn, that ſpectators were admitted on the ſtage, and that the critics and wits of the time uſually ſat there. Some were placed on the ground; others ſat on ſtools, of which the price was either 6 d. or 1 s. according, I ſuppoſe, to the commodiouſneſs of the ſituation; and they were attended by pages, who furniſhed them with pipes and tobacco, which was ſmoaked here as well as in other parts of the houſe; yet it ſhould ſeem that perſons were ſuffered to ſit on the ſtage only in the private play-houſes, ſuch as Blackfriars, &c. where the audience was more ſelect, and of a higher claſs; and that in the Globe and other public theatres no ſuch licence was permitted.

" The ſtage was ſtrewed with ruſhes, which, as we learn from Hentzner and Caius de Ephemera, was, in the time of Shakeſpeare, the uſual covering of floors in England. The curtain which hangs in the front of the preſent ſtage, drawn up by lines and pulleys, though not a modern invention, for it was uſed by Inigo Jones in the maſques at court, was yet an apparatus to which the ſimple mechaniſm of our ancient theatres had not arrived, for in them the curtains opened in the middle, and were drawn backwards and forwards on an iron rod. In ſome play-houſes they were woollen, in others made of ſilk.—Towards the rear of the ſtage there appears to have been a balcony, the platform of which was probably eight or ten feet from the ground. I ſuppoſe it to have been ſupported by pillars. From hence, in many of our old plays, part of the dialogue was ſpoken; and in the front of this balcony curtains likewiſe were hung.

" A doubt has been entertained whether in our ancient theatres there were ſide and other ſcenes. The queſtion is involved in ſo much obſcurity, that it is very difficult to form any decided opinion upon it. It is certain, that in the year 1605 Inigo Jones exhibited an entertainment at Oxford, in which moveable ſcenes were uſed; but he appears to have introduced ſeveral pieces of machinery in the maſques at court, with which undoubtedly the public theatres were unacquainted. A paſſage which has been produced from one of the old comedies, proves, it muſt be owned, that even theſe were furniſhed with ſome pieces of machinery, which were uſed when it was requiſite to exhibit the deſcent of ſome god or ſaint; but from all the contemporary accounts. I am inclined to believe that the mechaniſm of our ancient ſtage ſeldom went beyond a painted chair or a trap door, and that few, if any of them, had any moveable ſcenes. When king Henry VIII. is to be diſcovered by the dukes of Suffolk and Norfolk, reading in his ſtudy, the ſcenical direction in the firſt folio, 1623, (which was printed apparently from play-houſe copies), is, ' the king draws the curtain, (*i. e.* draws it open), and ſits reading penſively;' for, beſides the principal curtains that hung in the front of the ſtage, they uſed others as ſubſtitutes for ſcenes. If a bed-chamber is to be exhibited, no change of ſcene is mentioned; but the property-man is ſimply ordered to thruſt forth a bed. When the fable requires the Roman capitol to be exhibited, we find two officers enter, ' to lay cuſhions, as it were, in the capitol,' &c. On the whole, it appears, that our ancient theatres, in general, were only furniſhed with curtains, and a ſingle ſcene compoſed of tapeſtry, which were ſometimes, perhaps, ornamented with pictures; and ſome paſſages in our old dramas incline one to think, that when tragedies were performed the ſtage was hung with black.

" In the early part, at leaſt, of our author's [‡] acquaintance with the theatre, the want of ſcenery ſeems to have been ſupplied by the ſimple expedient of writing the names of the different places where the ſcene was laid in the progreſs of the play, which were diſpoſed in ſuch a manner as to be viſible to the audience. The invention of trap-doors, however, appears not to be modern; for in an old *morality*, intitled *All for Money*, we find a marginal direction which implies that they were very early in uſe. The covering, or internal roof of the ſtage, was anciently termed the heavens. It was probably painted of a ſky-blue colour, or perhaps pieces of drapery tinged with blue were ſuſpended acroſs the ſtage to repreſent the heavens.

" It is probable that the ſtage was formerly lighted by two large branches, of a form ſimilar to thoſe now hung in churches. They gave place in a ſubſequent period to ſmall circular wooden frames, furniſhed with candles, eight of which were hung on the ſtage, four at either ſide, and theſe within a few years were wholly removed by Mr Garrick, who, on his return from France, firſt introduced the preſent commodious method of illuminating the ſtage by lights not viſible to the audience. Many of the companies of players were formerly ſo thin, that one perſon played two or three parts; and a battle on which the fate of an empire was ſuppoſed to depend was decided by half a dozen combatants. It appears to have been a common practice in their mock engagements to diſcharge ſmall pieces of ordnance on the ſtage. Before the exhibition began, three flouriſhes or pieces of muſic were played, or, in the ancient language, there were three ſoundings. Muſic was likewiſe played between the acts. The inſtruments chiefly uſed were trumpets, cornets, and hautboys. The band, which did not conſiſt of more than five or ſix performers, ſat in an upper balcony, over what is now called the ſtage-box.

" The perſon who ſpoke the prologue was uſhered in by trumpets, and uſually wore a long black velvet cloak, which, I ſuppoſe, was conſidered as beſt ſuited to a ſupplicatory addreſs. Of this cuſtom, whatever might have been its origin, ſome traces remained till very lately, a black coat having been, if I miſtake not, within theſe few years, the conſtant ſtage-habiliment of our modern prologue-ſpeakers. The dreſs of the ancient prologue-ſpeaker is ſtill retained in the play that is exhibited in Hamlet before the king and court of Denmark. The performers of male characters generally wore periwigs, which in the age of Shakeſpeare were not in common uſe. It appears, from a paſſage in Puttenham's *Art of Engliſh Poeſy*, 1589, that vizards were on ſome occaſions uſed by the actors of thoſe days; and it may be inferred, from a ſcene in one of our author's comedies, that they were ſometimes worn in his time by thoſe who performed female characters; but this I imagine was very rare. Some of the female part of the audience likewiſe appeared in maſks. The ſtage-dreſſes, it is reaſonable to ſuppoſe, were much more coſtly at ſome theatres than at others; yet the wardrobe of even the king's ſervants at the Globe and Blackfriars, was, we find, but ſcantily furniſhed; and our author's dramas derived very little aid from the ſplendor of exhibition.

" It is well known, that in the time of Shakeſpeare and for many years afterwards, female characters were

[‡] Shakeſpeare.

repreſented by boys or young men. Sir William D'Avenant, in imitation of the foreign theatres, firſt introduced females in the ſcene, and Mrs Betterton is ſaid to have been the firſt woman that appeared on the Engliſh ſtage. Andrew Pennycuicke played the part of Matilda in a tragedy of Davenport's, in 1655; and Mr Kynaſton acted ſeveral female parts after the Reſtoration. Downes, a contemporary of his, aſſures us, ‘ that being then very young he made a complete ſtage beauty, performing his parts ſo well, particularly Arthiope and Aglaura, that it has ſince been diſputable among the judicious whether any woman that ſucceeded him touched the audience ſo ſenſibly as he.’

“ Both the prompter, or book-holder, as he was ſometimes called, and the property-man, appear to have been regular appendages of our ancient theatres. No writer that I have met with intimates, that in the time of Shakeſpeare it was cuſtomary to exhibit more than a ſingle dramatic piece on one day. The Yorkſhire tragedy, or *All's One*, indeed, appears to have been one of four pieces that were repreſented on the ſame day; and Fletcher has alſo a piece called *Four plays in One*; but probably theſe were either exhibited on ſome particular occaſion, or were ineffectual efforts to introduce a new ſpecies of amuſement; for we do not find any other inſtances of the ſame kind. Had any ſhorter pieces been exhibited after the principal performance, ſome of them probably would have been printed: but there are none extant of an earlier date than the time of the Reſtoration. The practice, therefore, of exhibiting two dramas ſucceſſively in the ſame evening, we may be aſſured was not eſtabliſhed before that period. But though the audiences in the time of our author were not gratified by the repreſentation of more than one drama in the ſame day, the entertainment was diverſified, and the populace diverted, by vaulting, tumbling, ſlight of hand, and morris-dancing, a mixture not much more heterogeneous than that with which we are daily preſented, a tragedy and a farce.

“ The amuſements of our anceſtors, before the commencement of the play, were of various kinds, ſuch as reading, playing at cards, drinking ale, or ſmoaking tobacco. It was a common practice to carry table-books to the theatre, and either from curioſity or enmity to the author, or ſome other motive, to write down paſſages of the play that was repreſented: and there is reaſon to believe that the imperfect and mutilated copies of ſome of Shakeſpear's dramas, which are yet extant, were taken down in ſhort-hand during the exhibition. At the end of the piece, the actors, in noblemen's houſes and in taverns, where plays were frequently performed, prayed for the health and proſperity of their patrons; and in the public theatres for the king and queen. This prayer ſometimes made part of the epilogue. Hence, probably, as Mr Steevens has obſerved, the addition of *Vivant rex et regina* to the modern play-bills.

“ Plays, in the time of our author, began at one o'clock in the afternoon; and the exhibition was uſually finiſhed in two hours. Even in 1667 they commenced at three. When Goſſon wrote his *School of Abuſe* in 1579, it ſeems the dramatic entertainments were uſually exhibited on Sundays. Afterwards they were performed on that and other days indiſcriminately. It appears from a contemporary writer, that exhibiting plays on Sunday had not been aboliſhed in the third year of king Charles I.

“ The modes of conveyance to the theatre, anciently as at preſent, ſeem to have been various; ſome going in coaches, others on horſeback, and many by water.—To the Globe play-houſe the company probably were conveyed by water; to that in Blackfriars the gentry went either in coaches or on horſeback, and the common people on foot. In an epigram to Sir John Davis, the practice of riding to the theatre is ridiculed as a piece of affectation or vanity, and therefore we may preſume it was not very general.

“ The long and whimſical titles that are prefixed to the quarto copies of our author's plays, I ſuppoſe to have been tranſcribed from the play-bills of the time. A contemporary writer has preſerved ſomething like a play-bill of theſe days, which ſeems to corroborate this obſervation; for if it were diveſted of rhime, it would bear no very diſtant reſemblance to the title pages that ſtand before ſome of our author's dramas:

“———Prithee, what's the play?
“ (The firſt I viſited this twelvemonth day)
“ They ſay—“ A new invented play of Purle,
“ That jeoparded his neck to ſteal a girl
“ Of twelve; and lying faſt impounded for't.
“ Has hither ſent his bearde to act his part;
“ Againſt all thoſe in open malice bent,
“ That would not freely to the theft conſent:
“ Feigns all to's wiſh, and in the epilogue
“ Goes out applauded for a famous—rogue.”
“ —Now hang me if I did not look at firſt
“ For ſome ſuch ſtuff, by the fond people's thruſt.”

“ It is uncertain at what time the uſage of giving authors a benefit on the third day of the exhibition of their pieces commenced. Mr Oldys, in one of his manuſcripts, intimates that dramatic poets had anciently their benefit on the firſt day that a new play was repreſented; a regulation which would have been very favourable to ſome of the ephemeral productions of modern times. But for this there is not, I believe, any ſufficient authority. From D'Avenant, indeed, we learn, that in the latter part of the reign of queen Elizabeth, the poet had his benefit on the ſecond day. As it was a general practice in the time of Shakeſpeare to ſell the copy of the play to the theatre, I imagine in ſuch caſes an author derived no other advantage from his piece that what aroſe from the ſale of it. Sometimes, however, he found it more beneficial to retain the copyright in his own hands; and when he did ſo, I ſuppoſe he had a benefit. It is certain that the giving authors the profit of the third exhibition of their play, which ſeems to have been the uſual mode during almoſt the whole of the laſt century, was an eſtabliſhed cuſtom in the year 1612; for Decker, in the prologue to one of his comedies printed in that year, ſpeaks of the poet's third day. The unfortunate Otway had no more than one benefit on the production of a new play; and this too, it ſeems, he was ſometimes forced to mortgage before the piece was acted. Southerne was the firſt dramatic writer who obtained the emoluments ariſing from two repreſentations; and to Farquhar, in the year 1700, the benefit of a third was granted. When an author ſold his piece to the ſharers or proprietors of a theatre, it remained for ſeveral years unpubliſhed; but when that was not the caſe, he printed it for ſale, to which many ſeem to have been induced, from an apprehenſion that an imperfect copy might be iſſued from the preſs without their conſent. The cuſtomary price of the copy of a play in the time of Shakeſpeare appears to have been twenty nobles, or ſix pounds thirteen ſhillings and fourpence. The play when printed was ſold for ſixpence; and the uſual preſent from a patron in return for a dedication was forty ſhillings. On the firſt day of exhibiting a new play the prices of admiſſion appear to have been raiſed; and this ſeems to have been occaſionally practiſed on the benefit-nights of authors to the end of the laſt century. The cuſtom of paſſing a final cenſure on plays at their firſt exhibition is as ancient as the time of our author; for no leſs than three plays of his rival Ben Jonſon appear to have been damned; and Fletcher's Faithful Shepherdeſs, and The Knight of the Burning Peſtle, written by him and Beaumont, underwent the ſame fate.

"It is not eaſy to aſcertian what were the emoluments of a ſucceſsful actor in the time of Shakeſpeare. They had not then annual benefits as at preſent. The performers at each theatre ſeem to have ſhared the profits ariſing either from each day's exhibition or from the whole ſeaſon among them. From Ben Johnſon's Poetaſter we learn, that one of either the performers or proprietors had ſeven ſhares and a half; but of what integral ſum is not mentioned. From the prices of admiſſion into our ancient theatres, which have been already mentioned, I imagine the utmoſt that the ſharers of the Globe play-houſe could have received on any one day was about L. 35. So lately as the year 1685, Shadwell received by his third day on the repreſentation of the Squire of Alſatia, L. 130; which Downes the prompter ſays was the greateſt receipt that had been ever taken at Drury-Lane play-houſe at ſingle prices. It appears from the MSS. of Lord Stanhope, treaſurer of the chambers to King James I. that the cuſtomary ſum paid to John Heminge and his company for the performance of a play at court was twenty nobles, or ſix pounds thirteen ſhillings and four-pence. And Edward Alleyn mentions in his Diary, that he once had ſo ſlender an audience in his theatre called the *Fortune*, that the whole receipts of the houſe amounted to no more than three pounds and ſome odd ſhillings.

"Thus ſcanty and meagre were the apparatus and accommodations of our ancient theatres, on which thoſe dramas were firſt exhibited, that have ſince engaged the attention of ſo many learned men, and delighted ſo many thouſand ſpectators. Yet even then, we are told by a writer of that age, 'that dramatic poeſy was ſo lively expreſſed and repreſented on the public ſtages and theatres of this city, as Rome in the age of her pomp and glory never ſaw it better performed; in reſpect of the action and art, not of the coſt and ſumptuouſneſs."

PLEA, in law, is what either party alleges for himſelf in court, in a cauſe there depending; and in a more reſtrained ſenſe, it is the defendant's anſwer to the plaintiff's declaration.

Pleas are uſually divided into thoſe of the crown and common pleas. Pleas of the crown are all ſuits in the king's name, or in the name of the attorney-general in behalf of the king, for offences committed againſt his crown and dignity, and againſt his peace; as treaſon, murder, felony, &c. See ARRAIGNMENT.

Blackſt. Comment.

Common pleas are ſuch ſuits as are carried on between common perſons in civil caſes. Theſe pleas are of two ſorts; *dilatory* pleas, and pleas *to the action*. Dilatory pleas are ſuch as tend merely to delay or put off the ſuit, by queſtioning the propriety of the remedy, rather than by denying the injury: pleas to the action are ſuch as diſpute the very cauſe of ſuit.

I. *Dilatory* pleas are, 1. to the juriſdiction of the court: alleging, that it ought not to hold plea of this injury, it ariſing in Wales or beyond ſea; or becauſe the land in queſtion is of ancient demeſne, and ought only to be demanded in the lord's court, &c. 2. To the diſability of the plaintiff, by reaſon whereof he is incapable to commence or continue the ſuit; as, that he is an alien enemy, outlawed, excommunicated, attainted of treaſon or felony, under a præmunire, not *in rerum natura* (being only a fictitious perſon), an infant, a feme-covert, or a monk profeſſed. 3. In abatement: which abatement is either of the writ, or the count, for ſome defect in one of them; as by miſnaming the defendant, which is called a *miſnomer*; giving him a wrong addition as eſquire inſtead of knight; or other want of form in any material reſpect. Or, it may be that the plaintiff is dead; for the death of either party is at once an abatement of the ſuit.

Theſe pleas to the juriſdiction, to the diſability, or in abatement, were formerly very often uſed as mere dilatory pleas, without any foundation in truth, and calculated only for delay; but now by ſtat. 4 & 5 Ann. c. 16. no dilatory plea is to be admitted without affidavit made of the truth thereof, or ſome probable matter ſhown to the court to induce them to believe it true. And with reſpect to the pleas themſelves, it is a rule that no exception ſhall be admitted againſt a declaration or writ, unleſs the defendant will in the ſame plea give the plaintiff a better; that is, ſhow him how it might be amended, that there may not be two objections upon the ſame account.

All pleas to the juriſdiction conclude to the cognizance of the court; praying "judgment whether the court will have farther cognizance of the ſuit." Pleas to the diſability conclude to the perſon; by praying "judgment, if the ſaid A the plaintiff ought to be anſwered:" And pleas in abatement (when the ſuit is by original) conclude to the writ, or declaration; by praying "judgment of the writ, or declaration, and that the ſame may be quaſhed," *caſſetur*, made void, or abated: but if the action be by bill, the plea muſt pray "judgement of the bill," and not of the declaration; the bill being here the original, and the declaration only a copy of the bill.

When theſe dilatory pleas are allowed, the cauſe is either diſmiſſed from that juriſdiction, or the plaintiff is ſtayed till his diſability be removed; or he is obliged to ſue out a new writ, by leave obtained from the court, or to amend and new-frame his declaration. But when, on the other hand, they are over-ruled as frivolous, the defendant has judgment of *reſpondeat ouſter*, or to anſwer over in ſome better manner. It is then incumbent on him to plead.

2. A plea *to the action*; that is, to anſwer to the merits of the complaint. This is done by confeſſing or denying it.

A confeſſion of the whole complaint is not very uſual; for then the defendant would probably end the matter ſooner, or not plead at all, but ſuffer judgment to go by default. Yet ſometimes, after tender and refuſal of a debt, if the creditor haraſſes his debtor with an action, it then becomes neceſſary for the defendant to acknowledge the debt, and plead the tender; adding, that he has always been ready, *tout temps priſt* and is ſtill ready, *uncore pres*, to diſcharge it: for a tender by the debtor and refuſal by the creditor will in all caſes diſcharge the coſts, but not the debt itſelf; though in ſome particular caſes the creditor will totally loſe his money. But frequently the defendant confeſſes one part of the complaint (by a *cognovit actionem* in reſpect thereof), and traverſes or denies the reſt; in order to avoid the expence of carrying that part to a formal trial, which he has no ground to litigate. A ſpecies of this ſort of confeſſion is the *payment of money into court:* which is for the moſt part neceſſary upon pleading a tender, and is itſelf a kind of tender to the plaintiff; by paying into the hands of the proper officers of the court as much as the defendant acknowledges to be due, together with the coſts hitherto incurred, in order to prevent the expence of any farther proceedings. This may be done upon what is called a *motion;* which is an occaſional application to the court by the parties or their counſel, in order to obtain ſome rule or order of court, which becomes neceſſary in the progreſs of a cauſe; and it is uſually grounded upon an *affidavit* (the perfect tenſe of the verb *affido*), being a voluntary oath before ſome judge or officer of the court, to evince the truth of certain facts, upon which the motion is grounded: though no ſuch affidavit is neceſſary for payment of money into court. If, after the money is paid in, the plaintiff proceeds in his ſuit, it is at his own peril: for if he does not prove more due than is ſo paid into court, he ſhall be nonſuited and pay the defendant's coſts; but he ſhall ſtill have the money ſo paid in, for that the defendant has acknowledged to be his due. To this head may alſo be referred the practice of what is called a *ſet off;* whereby the defendant acknowledges the juſtice of the plaintiff's demand on the one hand, but on the other, ſets up a demand of his own, to counterbalance that of the plaintiff, either in the whole or in part; as, if the plaintiff ſues for ten pounds due on a note of hand, the defendant may ſet off nine pounds due to himſelf for merchandize ſold to the plaintiff; and, in caſe he pleads ſuch ſet-off, muſt pay the remaining balance into court.

Pleas that totally deny the cauſe of complaint are either the general iſſue, or a ſpecial plea in bar.

1. The *general iſſue* or general plea, is what traverſes, thwarts, and denies at once, the whole declaration, without offering any ſpecial matter whereby to evade it. As in treſpaſs either *vi et armis*, or on the caſe, "*non culpabilis*, not guilty;" in debt upon contract, "*nihil debet*, he owes nothing;" in debt on bond, "*non eſt factum*, it is not his deed;" on an *aſſumpſit*, "*non aſſumpſit*, he made no ſuch promiſe." Or in real actions, "*nul tort*, no wrong done; *nul diſſeiſin*, no diſſeiſin;" and in a writ of right, the miſe or iſſue is, that "the tenant has more right to hold than the demandant has to demand." Theſe pleas are called the *general iſſue*, becauſe, by importing an abſolute and general denial of what is alleged in the declaration, they amount at once to an iſſue: by which we mean a fact affirmed on one ſide and denied on the other.

2. *Special* pleas in bar of the plaintiff's demands are very various, according to the circumſtances of the defendant's caſe. As, in real actions, a general releaſe or a fine; both of which may deſtroy and bar the plaintiff's title. Or, in perſonal actions, an accord, arbitration, conditions performed, nonage of the defendant, or ſome other fact which precludes the plaintiff from his action. A *juſtification* is likewiſe a ſpecial plea in bar; as in actions of aſſault and battery, *ſon aſſault demeſne*, that it was the plaintiff's own original aſſault; in treſpaſs, that the defendant did the thing complained of in right of ſome office which warranted him ſo to do; or, in an action of ſlander, that the plaintiff is really as bad a man as the defendant ſaid he was.

Alſo a man may plead the ſtatutes of limitation in bar; or the time limited by certain acts of parliament, beyond which no plaintiff can lay his cauſe of action. This, by the ſtatute of 32 Hen. VIII. c. 2. in a writ of right is 60 years: in aſſiſes, writs of entry, or other poſſeſſory actions real, of the ſeiſin of one's anceſtors in lands; and either of their ſeiſin, or one's own, in rents, ſuits, and ſervices, 50 years: and in actions real for lands grounded upon one's own ſeiſin or poſſeſſion, ſuch poſſeſſion muſt have been within 30 years. By ſtatute 1 Mar. ſt. 2. c. 5. this limitation does not extend to any ſuit for avowſons. But by the ſtatute 21 Jac. I. c. 2. a time of limitation was extended to the caſe of the king; viz. 60 years precedent to 19th Feb. 1623: but, this becoming ineffectual by efflux of time, the ſame date of limitation was fixed by ſtatute 9 Geo. III. c. 16. to commence and be reckoned backwards, from the time of bringing any ſuit or other proceſs to recover the thing in queſtion; ſo that a poſſeſſion for 60 years is now a bar even againſt the prerogative, in derogation of the ancient maxim, *Nullum tempus occurrit regi.* By another ſtatute, 21 Jac. I. c. 16. 20 years is the time of limitation in any writ of formedon: and, by a conſequence, 20 years is alſo the limitation in every action of ejectment; for no ejectment can be brought, unleſs where the leſſor of the plaintiff is intitled to enter on the lands, and by the ſtatute 21 Jac. I. c. 16. no entry can be made by any man, unleſs within 20 years after his right ſhall accrue. Alſo all actions of treſpaſs (*quare clauſum fregit*, or otherwiſe), detinue, trover, replevin, account, and caſe (except upon accounts between merchants), debt on ſimple contract, or for arrears of rent, are limited by the ſtatute laſt mentioned to ſix years after the cauſe of action commenced: and actions of aſſault, menace, battery, mayhem, and impriſonment, muſt be brought within four years, and actions for words two years, after the injury committed. And by the ſtatute 31 Eliz. c. 5. all ſuits, indictments, and informations, upon any penal ſtatutes, where any forfeiture is to the crown, ſhall be ſued within two years, and where the forfeiture is to a ſubject, within one year, after the offence committed, unleſs where any other time is ſpecially limited by the ſtatute. Laſtly, by ſtatute 10 W. III. c. 14. no writ of error, *ſcire facias*, or other ſuit, ſhall be brought to reverſe any judgment, fine, or recovery, for error, unleſs it be proſecuted within 20 years. The uſe of theſe ſtatutes of limitation is to preſerve the peace of the kingdom, and to prevent thoſe innumerable perjuries which might enſue if a man were allowed to bring an action for any injury committed at any diſtance of time. Upon both theſe accounts the law therefore holds, that *intereſt reipublicæ ut ſit finis litium:* and upon the ſame principle the Athenian laws in general prohibited all actions where the injury was committed five years before the complaint was made. If therefore, in any ſuit, the injury, or cauſe of action, happened earlier than the period expreſsly limited by law, the defendant may plead the ſtatutes of limitations in bar: as upon an *aſſumpſit*, or promiſe to pay money to the plaintiff, the defendant may plead, *Non aſſumpſit infra ſex annos*, He made no ſuch promiſe within ſix years; which is an affectual bar to the complaint.

An *eſtoppel* is likewiſe a ſpecial plea in bar; which happens where a man hath done ſome act, or executed ſome deed, which eſtops or precludes him from averring any thing to the contrary. As if a tenant for years (who hath no freehold) levies a fine to another perſon. Though this is void as to ſtrangers, yet it ſhall work as an eſtoppel to the cognizor; for, if he afterwards brings an action to recover theſe lands, and his fine is pleaded againſt him, he ſhall thereby be eſtopped from ſaying, that he had no freehold at the time, and therefore was incapable of levying it.

The conditions and qualities of a plea (which, as well as the doctrine of eſtoppels, will alſo hold equally, *mutatis mutandis*, with regard to other parts of pleading), are, 1. That it be ſingle and containing only one matter; for duplicity begets confuſion. But by ſtatute 4 and 5 Ann. c. 16. a man, with leave of the court, may plead two or more diſtinct matters or ſingle pleas; as in an action of aſſault and battery, theſe three, Not guilty, *ſon aſſault demeſne*, and the ſtatute of limitations. 2. That it be direct and poſitive, and not argumentative. 3. That it have convenient certainty of time, place, and perſons. 4. That it anſwer the plaintiff's allegations in every material point. 5. That it be ſo pleaded as to be capable of trial.

Special pleas are uſually in the affirmative, ſometimes in the negative, but they always advance ſome new fact not mentioned in the declaration; and then they muſt be averred to be true in the common form:—"And this he is ready to verify."—This is not neceſſary in pleas of the general iſſue, thoſe always containing a total denial of the facts before advanced by the other party, and therefore putting him upon the proof of them. See PLEADINGS.

Blackſt. Comment.

PLEA to Indictment, the defenſive matter alleged by a criminal on his indictment: (ſee ARRAIGNMENT.) This is either, 1. A plea to the juriſdiction; 2. A demurrer; 3. A plea in abatement; 4. A ſpecial plea in bar; or, 5. The general iſſue.

I. A plea to the *juriſdiction*, is where an indictment is taken before a court that hath no cognizance of the offence; as if a man be indicted for a rape at the ſheriff's tourn, or for treaſon at the quarter-ſeſſions: in theſe or ſimilar caſes, he may except to the juriſdiction of the court, without anſwering at all to the crime alleged.

II. A *demurrer* to the indictment, is incident to criminal caſes, as well as civil, when the fact as alleged is allowed to be true, but the priſoner joins iſſue upon ſome point of law in the indictment by which he inſiſts, that the fact, as ſtated, is no felony, treaſon, or whatever the crime is alleged to be. Thus, for inſtance, if a man be indicted for feloniouſly ſtealing a greyhound; which is an animal in which no valuable property can be had, and therefore it is not felony, but only a civil treſpaſs to ſteal it; in this caſe the party indicted may demur to the indictment; denying it to be felony, tho' he confeſſes the act of taking it. Some have held, that if, on demurrer, the point of law be adjudged againſt the priſoner, he ſhall have judgment and execution, as if convicted by verdict. But this is denied by others, who hold, that in ſuch caſe he ſhall be directed and received to plead the general iſſue, Not guilty, after a demurrer determined againſt him. Which appears the more reaſonable, becauſe it is clear, that if the priſoner freely diſcovers the fact in court, and refers it to the opinion of the court whether it be felony or no; and upon the fact thus ſhown, it appears to be felony, the court will not record the confeſſion, but admit him afterwards to plead not guilty. And this ſeems to be a caſe of the ſame nature, being for the moſt part a miſtake in point of law, and in the conduct of his pleading; and, though a man by miſpleading may in ſome caſes loſe his property, yet the law will not ſuffer him by ſuch niceties to loſe his life. However, upon this doubt, demurrers to indictments are ſeldom uſed: ſince the ſame advantages may be taken upon a plea of not guilty; or afterwards, in arreſt of judgment, when the verdict has eſtabliſhed the fact.

III. A plea in *abatement* is principally for a *miſnomer*, a wrong name, or a falſe addition to the priſoner. As, if James Allen, gentleman, is indicted by the name of *John Allen, eſquire*, he may plead that he has the name of *James*, and not of *John*; and that he is a *gentleman*, and not an *eſquire*. And, if either fact is found by a jury, then the indictment ſhall be abated, as writs or declarations may be in civil actions. But, in the end, there is little advantage accruing to the priſoner by means of theſe dilatory pleas; becauſe, if the exception be allowed, a new bill of indictment may be framed, according to what the priſoner in his plea avers to be his true name and addition. For it is a rule, upon all pleas in abatement, that he who takes advantage of a flaw, muſt at the ſame time ſhow how it may be amended. Let us therefore next conſider a more ſubſtantial kind of plea, *viz.*

IV. Special pleas in *bar*; which go to the merits of the indictment, and give a reaſon why the priſoner ought not to anſwer it at all, nor put himſelf upon his trial for the crime alleged. Theſe are of four kinds: a former acquittal, a former conviction, a former attainder, or a pardon. There are many other pleas which may be pleaded in bar of an appeal: but theſe are applicable to both appeals and indictments.

1. Firſt, the plea of *auterfoits acquit*, or a former acquittal, is grounded on this univerſal maxim of the common law of England, that no man is to be brought into jeopardy of his life, more than once, for the ſame offence. And hence it is allowed as a conſequence, that when a man is once fairly found not guilty upon any indictment, or other proſecution, before any court having competent juriſdiction of the offence, he may plead ſuch acquittal in bar of any ſubſequent accuſation for the ſame crime.

2. Secondly, the plea of *auterfoits convict*, or a former conviction for the ſame identical crime, though no judgment was ever given, or perhaps will be (being ſuſpended by the benefit of clergy or other cauſes), is a good plea in bar to an indictment. And this depends upon the ſame principle as the former, that no man ought to be twice brought in danger of his life for one and the ſame crime.

3. Thirdly, the plea of *auterfoits attaint*, or a former attainder, is a good plea in bar, whether it be for the ſame or any other felony. For wherever a man is attainted of felony by judgment of death either upon a verdict or confeſſion, by outlawry, or heretofore by abjuration, and whether upon an appeal or an indictment; he may plead ſuch attainder in bar to any ſubſequent indictment or appeal, for the ſame or for any other felony. And this becauſe, generally, ſuch proceeding on a ſecond proſecution cannot be to any purpoſe; for the priſoner is dead in law by the firſt attainder, his blood is already corrupted, and he hath forfeited all that he had: ſo that it is abſurd and ſuperfluous to endeavour to attaint him a ſecond time. Though to this general rule, as to all others, there are ſome exceptions; wherein, *ceſſante ratione, ceſſat et ipſa lex.*

4. Laſtly, a pardon may be pleaded in bar; as at once deſtroying the end and purpoſe of the indictment, by remitting that puniſhment, which the proſecution is calculated to inflict. There is one advantage that attends pleading a pardon in bar, or an arreſt of judgment, before ſentence is paſt; which gives it by much the preference to pleading it after ſentence or attainder. This is, that by ſtopping the judgment it ſtops the attainder, and prevents the corruption of the blood: which, when once corrupted by attainder, cannot afterwards be reſtored otherwiſe than by act of parliament.

V. The *general iſſue*, or plea of not guilty, upon which plea alone the priſoner can receive his final judgment of death. In caſe of an indictment of felony or treaſon, there can be no ſpecial juſtification put in by way of plea. As, on an indictment for murder, a man cannot plead that it was in his own defence againſt a robber on the highway, or a burglar; but he muſt plead the general iſſue, Not guilty, and give this ſpecial matter in evidence. For (beſides that theſe pleas do in effect amount to the general iſſue; ſince, if true, the priſoner is moſt clearly not guilty) as the facts in treaſon are ſaid to be done *proditore et contra ligantiæ ſuæ debitum;* and, in felony, that the killing was done *felonice;* theſe charges, of a traiterous or felonious intent, are the points and very *giſt* of the indictment, and muſt be anſwered directly by the general negative, Not guilty; and the jury upon the evidence will take notice of any defenſive matter, and give their verdict accordingly as effectually as if it were or could be ſpecially pleaded. So that this is, upon all accounts, the moſt advantageous plea for the priſoner.

When the priſoner hath thus pleaded not guilty, *non culpabilis*, or *nient culpable:* which was formerly uſed to be abbreviated upon the minutes, thus, *Non* (or *nient) cul.* the clerk of the aſſize, or clerk of arraigns, on behalf of the crown replies, that the priſoner is guilty, and that he is ready to prove him ſo. This is done by two monoſyllables in the ſame ſpirit of abbreviation, *cul.prit.*: which ſignifies firſt that the priſoner is guilty, *(cul. culpable*, or *culpabilis);* and then that the king is ready to prove him ſo, *(priſt, præſto ſum*, or *paratus, verificare)*. By this replication the king and the priſoner are therefore at iſſue: for when the parties come to a fact which is affirmed on one ſide and denied on the other, then they are ſaid to be at iſſue in point of fact: which is evidently the caſe here, in the plea of *non cul.* by the priſoner; and the replication of *cul.* by the clerk.

How the courts came to expreſs a matter of this importance in ſo odd and obſcure a manner, can hardly be pronounced with certainty. It may perhaps, however, be accounted for by ſuppoſing, that theſe were at firſt ſhort notes, to help the memory of the clerk, and remind him what he was to reply; or elſe it was the ſhort method of taking down in court, upon the minutes, the replication and averment; *cul. priſt:* which afterwards the ignorance of ſucceeding clerks adopted for the very words to be by them ſpoken (A).

But however it may have ariſen, the joining of iſſue ſeems to be clearly the meaning of this obſcure expreſſion; which has puzzled our moſt ingenious etymologiſts, and is commonly underſtood as if the clerk of the arraigns, immediately on plea pleaded, had fixed an opprobrious name on the priſoner, by aſking him, "*culprit*, how wilt thou be tried?" for immediately upon iſſue joined it is inquired of the priſoner, by what trial he will make his innocence appear. This form has at preſent reference to appeals and approvements only, wherein the appellee has his choice, either to try the accuſation by BATTLE or by JURY. But upon indictments, ſince the abolition of ORDEAL, there can be no other trial but by jury, *per pais*, or by the country: and therefore, if the priſoner refuſes to put himſelf upon the inqueſt in the uſual form, that is, to anſwer that he will be tried by God and the country, if a commoner; and, if a peer, by God and his peers; the indictment, if in treaſon, is taken *pro conſeſſo;* and the priſoner, in caſes of felony, is judged to ſtand mute, and, if he perſeveres in his obſtinacy, ſhall now be convicted of the felony.

When the priſoner has thus put himſelf upon his trial the clerk anſwers in the humane language of the law, which always hopes that the party's innocence rather than his guilt may appear, "God ſend thee a good deliverance." And then they proceed, as ſoon as conveniently may be, to the trial. See the article TRIAL.

PLEADINGS, in law, are the mutual altercations between the plaintiff and defendant, (ſee SUIT, WRIT, and PROCESS). They form the third part or ſtage of a fact; and at preſent are ſet down and delivered into the proper office in writing, though formerly they were uſually put in by their council *ore tenus*, or *viva voce*, in court, and then minuted down by the chief clerks or prothonotaries; whence, in our old law-French, the pleadings are frequently denominated the *parol*.

The firſt of theſe is the *declaration, narratio*, or *count*, anciently called the *tale;* in which the plaintiff ſets forth his cauſe of complaint at length: being indeed only an amplification

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(A) Of this ignorance we may ſee daily inſtances, in the abuſe of two legal terms of ancient French: one, the prologue to all proclamations, "*Oyez*, or Hear ye," which is generally pronounced, moſt unmeaningly, "O yes: the other, a more pardonable miſtake, viz. when a jury are all ſworn, the officer bids the crier number them, for which the word in law French is "*Coutez;*" but we now hear it pronounced in very good Engliſh, "Count theſe."

Blackſt. Comment.

amplification or expoſition of the original writ upon which his action is founded, with the additional circumſtances of time and place, when and where, the injury was committed.

In *local* actions, where poſſeſſion of land is to be recovered, or damages for an actual treſpaſs, or for waſte, &c. affecting land, the plaintiff muſt lay his declaration, or declare his injury to have happened in the very county and place that it really did happen; but in *tranſitory* actions, for injuries that might have happened anywhere, as debt, detinue, ſlander, and the like, the plaintiff may declare in what county he pleaſes, and then the trial muſt be in that county in which the declaration is laid. Though, if the defendant will make affidavit that the cauſe of action, if any, aroſe not in that but another county, the court will direct a change of *the venue* or *viſne* (that is, the *vicinia* or neighbourhood in which the injury is declared to be done), and will oblige the plaintiff to declare in the proper county. For the ſtatute 6 Ric. II. c. 2. having ordered all writs to be laid in their proper counties, this, as the judges conceived, impowered them to change the *venue*, if required, and not to inſiſt rigidly on abating the writ: which practice began in the reign of James I. And this power is diſcretionally exerciſed, ſo as not to cauſe but prevent a defect of juſtice. Therefore the court will not change the *venue* to any of the four northern counties previous to the ſpring circuit; becauſe there the aſſiſes are holden only once a-year, at the time of ſummer circuit. And it will ſometimes remove the *venue* from the proper juriſdiction (eſpecially of the narrow and limited kind), upon a ſuggeſtion, duly ſupported, that a fair and impartial trial cannot be had therein.

It is generally uſual, in actions upon the caſe, to ſet forth ſeveral caſes, by different counts in the ſame declaration; ſo that if the plaintiff fails in the proof of one, he may ſucceed in another. As in an action on the caſe upon an ASSUMPSIT for goods ſold and delivered, the plaintiff uſually counts or declares, firſt, upon a ſettled and agreed price between him and the defendant; as, that they bargained for 20l.: and leſt he ſhould fail in the proof of this, he counts likewiſe upon a *quantum valebant;* that the defendant bought other goods, and agreed to pay him ſo much as they were reaſonably worth: and then avers that they were worth other 20l. and ſo on in three or four different ſhapes; and at laſt concludes with declaring, that the defendant had refuſed to fulfil any of theſe agreements, whereby he is endamaged to ſuch a value. And if he proves the caſe laid in any one of his counts, though he fails in the reſt, he ſhall recover proportionable damages, This declaration always concludes with theſe words, "and thereupon he brings ſuit," &c. *inde producit ſectam, &c.* By which words, *ſuit* or *ſecta (a ſequendo)*, were anciently underſtood the witneſſes or followers of the plaintiff. For in former times, the law would not put the defendant to the trouble of anſwering the charge till the plaintiff had made out at leaſt a probable caſe. But the actual production of the *ſuit, ſecta,* or *followers*, is now antiquated, and hath been totally diſuſed, at leaſt ever ſince the reign of Edward III. though the form of it ſtill continues.

At the end of the declaration are added alſo the plaintiff's common pledges of proſecution, John Doe and Richard Roe; which, as we elſewhere obſerve, (ſee WRIT), are now mere names of form; though formerly they were of uſe to anſwer to the king for the amercement of the plaintiff, in caſe he were nonſuited, barred of his action, or had a verdict and judgment againſt him. For if the plaintiff neglects to deliver a declaration for two terms after the defendant appears, or is guilty of other delays or defaults againſt the rules of law in any ſubſequent ſtage of the action, he is adjudged not to follow or purſue his remedy as he ought to do; and thereupon a *nonſuit*, or *non proſequitur*, is entered, and he is ſaid to be *non-proſ*'d. And for thus deſerting his complaint, after making a falſe claim or complaint (*pro falſo clamore ſuo*), he ſhall not only pay coſts to the defendant, but is liable to be amerced to the king. A *retraxit* differs from a nonſuit, in that the one is negative and the other poſitive: the nonſuit is a default and neglect of the plaintiff, and therefore he is allowed to begin his ſuit again upon payment of coſts; but a *retraxit* is an open and voluntary renunciation of his ſuit in court; and by this he for ever loſes his action. A *diſcontinuance* is ſomewhat ſimilar to a nonſuit; for when a plaintiff leaves a chaſm in the proceedings of his cauſe, as by not continuing the proceſs regularly from day to day, and time to time, as he ought to do, the ſuit is diſcontinued, and the defendant is no longer bound to attend; but the plaintiff muſt begin again, by ſuing out a new original, uſually paying coſts to his antagoniſt.

When the plaintiff hath ſtated his caſe in the declaration, it is incumbent on the defendant, within a reaſonable time, to make his defence, and to put in a plea; or elſe the plaintiff will at once recover judgment by *default* or *nihil dicit*, of the defendant.

Defence, in its true legal ſenſe, ſignifies not a juſtification, protection, or guard, which is now its popular ſignification; but merely an *oppoſing* or *denial* (from the French verb *defendre)* of the truth or validity of the complaint. It is the *conteſtatio litis* of the civilians: a general aſſertion that the plaintiff hath no ground of action; which aſſertion is afterwards extended and maintained in his plea.

Before defence made, if at all, cognizance of the ſuit muſt be claimed or demanded; when any perſon or body-corporate hath the franchiſe, not only of holding pleas within a particular limited juriſdiction, but alſo of the cognizance of pleas; and that either without any words excluſive of other courts, which intitles the lord of the franchiſe, whenever any ſuit that belongs to his juriſdiction is commenced in the courts at Weſtminſter, to demand the cognizance thereof; or with ſuch excluſive words, which alſo intitle the defendant to plead to the juriſdiction of the court. Upon this claim of cognizance, if allowed, all proceedings ſhall ceaſe in the ſuperior court, and the plaintiff is left at liberty to purſue his remedy in the ſpecial juriſdiction. As when a ſcholar or other privileged perſon of the univerſities of Oxford or Cambridge is impleaded in the courts at Weſtminſter, for any cauſe of action whatſoever, unleſs upon a queſtion of freehold. In theſe caſes, by the charter of thoſe learned bodies, confirmed by act of parliament, the chancellor, or vice-chancellor, may put in a claim of cognizance; which, if made in due time and form, and with due proof of the facts alleged is regularly

Pleadings.

larly allowed by the courts. It muſt be demanded before full defence is made or imparlance prayed; for theſe are a ſubmiſſion to the juriſdiction of the ſuperior court, and the delay is a *laches* in the lord of the franchiſe; and it will not be allowed if it occaſions a failure of juſtice, or if an action be brought againſt the perſon himſelf who claims the franchiſe, unleſs he hath alſo a power in ſuch caſe of making another judge.

After defence made, the defendant muſt put in his plea. But before he defends, if the ſuit is commenced by *capias* or *latitat*, without any ſpecial original, he is intitled to demand one *imparlance*, or *licentia loquendi*; and may, before he pleads, have more granted by conſent of the court, to ſee if he can end the matter amicably without farther ſuit, by talking with the plaintiff: a practice which is ſuppoſed to have ariſen from a principle of religion, in obedience to that precept of the goſpel, "agree with thine adverſary quickly, whilſt thou art *in the way* with him." And it may be obſerved, that this goſpel-precept has a plain reference to the Roman law of the twelve tables, which expreſsly directed the plaintiff and defendant to make up the matter while they were in the way, or going to the prætor;—*in via, rem uti pacent orato.* There are alſo many other previous ſteps which may be taken by a defendant before he puts in his plea. He may, in real actions, demand a view of the thing in queſtion, in order to aſcertain its indentity and other circumſtances. He may crave *oyer* of the writ, or of the bond, or other ſpecialty upon which the action is brought; that is, to hear it read to him; the generality of defendants in the times of ancient ſimplicity being ſuppoſed incapable to read it themſelves: whereupon the whole is entered *verbatim* upon the record; and the defendant may take advantage of any condition, or other part of it, not ſtated in the plaintiff's declaration. In real actions alſo the tenant may pray in *aid*, or call for the aſſiſtance of another, to help him to plead, becauſe of the feebleneſs or imbecility of his own eſtate. Thus a tenant for life may pray in aid of him that hath the inheritance in remainder or reverſion; and an incumbent may pray in aid of the patron and ordinary; that is, that they ſhall be joined in the action, and help to defend the title. *Voucher* alſo is the calling in of ſome perſon to anſwer the action, that hath warranted the title to the tenant or defendant. This we ſtill make uſe of in the form of common recoveries, which are grounded on a writ of entry; a ſpecies of action that relies chiefly on the weakneſs of the tenant's title, who therefore vouches another perſon to warrant it. If the vouchee appears, he is made defendant inſtead of the voucher; but if he afterwards makes default, recovery ſhall be had againſt the original defendant; and he ſhall recover an equivalent in value againſt the deficient vouchee. In aſſizes, indeed, where the principal queſtion is, whether the demandant or his anceſtors were or were not in poſſeſſion till the ouſter happened, and the title of the tenant is little (if at all) diſcuſſed, there no voucher is allowed; but the tenant may bring a writ of *warrantia chartæ* againſt the warrantor, to compel him to aſſiſt him with a good plea or defence, or elſe to render damages and the value of the land, if recovered againſt the tenant. In many real actions alſo, brought by or againſt an infant under the age of 21 years, and alſo in actions of debt brought againſt him, as heir to any deceaſed anceſtor, either party may ſuggeſt the nonage of the infant, and pray that the proceedings may be deferred till his full age, or in our legal phraſe, that the infant may have his age, and that the *parol may demur*, that is, that the pleadings may be ſtaid; and then they ſhall not proceed till his full age, unleſs it be apparent that he cannot be prejudiced thereby. But by the ſtatutes of Weſtm. 1. 3. Edw. I. c. 46. and of Gloceſter, 6 Edw. I. c. 2. in writs of entry *ſur diſſeiſin* in ſome particular caſes, and in actions anceſtrel brought by an infant, the parol ſhall not demur; otherwiſe he might be deforced of his whole property, and even want a maintenance, till he came of age. So likewiſe in a writ of dower the heir ſhall not have his age; for it is neceſſary that the widow's claim be immediately determined, elſe ſhe may want a preſent ſubſiſtence. Nor ſhall an infant patron have it in a *quare impedit*, ſince the law holds it neceſſary and expedient that the church be immediately filled.

When theſe proceedings are over, the defendant muſt then put in his excuſe or plea. See PLEA.

It is a rule in pleading, that no man be allowed to plead ſpecially ſuch a plea as amounts only to the general iſſue, or a total denial of the charge; but in ſuch caſe he ſhall be driven to plead the general iſſue in terms, whereby the whole queſtion is referred to a jury. But if the defendant, in an aſſize or action of treſpaſs, be deſirous to refer the validity of his title to the court rather than the jury, he may ſtate his title ſpecially; and at the ſame time give colour to the plaintiff, or ſuppoſe him to have an appearance or colour of title, bad indeed in point of law, but of which the jury are not competent judges. As if his own true title is, that he claims by feoffment with livery from A, by force of which he entered on the lands in queſtion, he cannot plead this by itſelf, as it amounts to no more than the general iſſue, *nul tort, nul diſſeiſin*, in aſſize, or *not guilty* in an action of treſpaſs. But he may allege this ſpecially, provided he goes farther, and ſays, that the plaintiff claiming by colour of a prior deed of feoffment, without livery, entered; upon whom he entered; and may then refer himſelf to the judgment of the court which of theſe two titles is the beſt in point of law.

When the plea of the defendant is thus put in, if it does not amount to an iſſue or total contradiction of the declaration, but only evades it, the plaintiff may plead again, and reply to the defendant's plea: Either traverſing it, that is, totally denying it; as if, on an action of debt upon bond, the defendant pleads *ſolvit ad diem*, that he paid the money when due; here the plaintiff in his replication may totally traverſe this plea, by denying that the defendant paid it: Or he may allege new matter in contradiction to the defendant's plea: as when the defendant pleads no award made, the plaintiff may reply, and ſet forth an actual award, and aſſign a breach: Or the replication may confeſs and avoid the plea, by ſome new matter or diſtinction, conſiſtent with the plaintiff's former declaration; as in an action for treſpaſſing upon land whereof the plaintiff is ſeized, if the defendant ſhows a title to the land by deſcent, and that therefore he had a right to enter, and gives colour to the plaintiff, the plaintiff may either traverſe and totally deny the fact of the deſcent; or he may confeſs and avoid it, by replying, that true it is that ſuch deſcent

ſcent happened, but that ſince the deſcent the defendant himſelf demiſed the lands to the plaintiff for term of life. To the replication the defendant may *rejoin*, or put in an anſwer called a *rejoinder*. The plaintiff may anſwer the rejoinder by a *ſur rejoinder*; upon which the defendant may *rebut*, and the plaintiff anſwer him by a *ſur-rebutter*. Which pleas, replications, rejoinders, ſur-rejoinders, rebutters, and ſur-rebutters, anſwer to the *exceptio*, *replicatio*, *duplicatio*, *triplicatio*, and *quadruplicatio*, of the Roman laws.

The whole of this proceſs is denominated the *pleading*; in the ſeveral ſtages of which it muſt be careſully obſerved, not to depart or vary from the title or defence which the party has once inſiſted on. For this (which is called a *departure* in pleading) might occaſion endleſs altercation. Therefore the replication muſt ſupport the declaration, and the rejoinder muſt ſupport the plea, without departing out of it. As in the caſe of pleading no award made in conſequence of a bond of arbitration, to which the plaintiff replies, ſetting forth an actual award; now the defendant cannot rejoin that he hath performed this award, for ſuch rejoinder would be an entire departure from his original plea, which alleged that no ſuch award was made: therefore he has now no other choice, but to traverſe the fact of the replication, or elſe to demur upon the law of it.

Again, all duplicity in pleading muſt be avoided. Every plea muſt be ſimple, entire, connected, and confined to one ſingle point: it muſt never be entangled with a variety of diſtinct independent anſwers to the ſame matter; which muſt require as many different replies, and introduce a multitude of iſſues upon one and the ſame diſpute. For this would often embarraſs the jury, and ſometimes the court itſelf, and at all events would greatly enhance the expence of the parties. Yet it frequently is expedient to plead in ſuch a manner as to avoid any implied admiſſion of a fact, which cannot with propriety or ſafety be poſitively affirmed or denied. And this may be done by what is called a *proteſtation*; whereby the party interpoſes an oblique allegation or denial of ſome fact, proteſting (by the gerund, *proteſtando*) that ſuch a matter does or does not exiſt; and at the ſame time avoiding a direct affirmation or denial. Sir Edward Coke hath defined a proteſtation (in the pithy dialect of that age) to be, "an excluſion of a concluſion." For the uſe of it is, to ſave the party from being concluded with reſpect to ſome fact or circumſtance which cannot be directly affirmed or denied without falling into duplicity of pleading; and which yet, if he did not thus enter his proteſt, he might be deemed to have tacitly waved or admitted. Thus, while tenure in villainage ſubſiſted, if a villain had brought an action againſt his lord, and the lord was inclined to try the merits of the demand, and at the ſame time to prevent any concluſion againſt himſelf that he had waved his ſigniory; he could not in this caſe both plead affirmatively that the plaintiff was his villain, and alſo take iſſue upon the demand; for then his plea would have been double, as the former alone would have been a good bar to the action: but he might have alleged the villainage of the plaintiff by way of proteſtation, and then have denied the demand. By this means the future vaſſalage of the plaintiff was ſaved to the defendant, in caſe the iſſue was found in his (the defendant's) favour; for the proteſtation prevented that concluſion which would otherwiſe have reſulted from the reſt of his defence, that he had enfranchiſed the plaintiff, ſince no villain could maintain a civil action againſt his lord. So alſo if a defendant, by way of inducement to the point of his defence, alleges (among other matters) a particular mode of ſeiſin or tenure which the plaintiff is unwilling to admit, and yet deſires to take iſſue on the principal point of the defence, he muſt deny the ſeiſin or tenure by way of proteſtation, and then traverſe the defenſive matter. So, laſtly, if an award be ſet forth by the plaintiff, and he can aſſign a breach in one part of it (viz. the non-payment of a ſum of money), and yet is afraid to admit the performance of the reſt of the award, or to aver in general a non-performance of any part of it, leſt ſomething ſhould appear to have been performed; he may ſave to himſelf any advantage he might hereafter make of the general non-performance, by alleging that by proteſtation, he can plead only the non-payment of the money.

In any ſtage of the pleadings, when either ſide advances or affirms any new matter, he uſually (as was ſaid) avers it to be true; "and this he is ready to verify." On the other hand, when either ſide traverſes or denies the facts pleaded by his antagoniſt, he uſually tenders an *iſſue*, as it is called; the language of which is different according to the party by whom it is tendered; for if the traverſe or denial comes from the defendant, the iſſue is tendered in this manner, "And of this he puts himſelf upon the country," thereby ſubmitting himſelf to the judgment of his peers: but if the traverſe lies upon the plantiff, he tenders the iſſue or prays the judgment of the peers againſt the defendant in another form; thus, "and this he prays may be inquired of by the country."

But if either ſide (as, for inſtance, the defendant) pleads a ſpecial negative plea, not traverſing or denying any thing that was before alleged, but diſcloſing ſome new negative matter; as where the ſuit is on a bond conditioned to perform an award, and the defendant pleads, negatively, that no award was made; he tenders no iſſue upon this plea, becauſe it does not yet appear whether the fact will be diſputed, the plaintiff not having yet aſſerted the exiſtence of any award: but when the plaintiff replies, and ſets forth an actual ſpecific award, if then the defendant traverſes the replication, and denies the making of any ſuch award, he then, and not before, tenders an iſſue to the plaintiff. For when in the courſe of pleading they come to a point which is affirmed on one ſide and denied on the other, they are then ſaid to be at iſſue; all their debates being at laſt contracted into a ſingle point, which muſt now be determined either in favour of the plaintiff or of the defendant. See Issue.

PLEASING, art of. See Politeness.

PLEASURE is a word ſo univerſally underſtood as to need no explanation. Lexicographers, however, who muſt attempt to explain every word, call it "the gratification of the mind or ſenſes." It is directly oppoſite to Pain, and conſtitutes the whole of poſitive happineſs as that does of miſery.

The Author of Nature has furniſhed us with many pleaſures, as well as made us liable to many pains; and we are ſuſceptible of both in ſome degree as ſoon as we have life and are endowed with the faculty of ſenſation. A French writer, in a work* which once raiſed high

* Encyclopédie Methodique, Logique, Metaphyſique, et Morale, tom. 4.

expectations, contends, that a child in the womb of its mother feels neither pleaſure nor pain. “Theſe ſenſations (ſays he) are not innate; they have their origin from without: and it is at the moment of our birth that the ſoul receives the firſt impreſſions; impreſſions ſlight and ſuperficial at the beginning, but which by time and repeated acts leave deeper traces in the ſenſorium, and become more extenſive and more laſting. It is when the child ſends forth its firſt cries that ſenſibility or the faculty of ſenſation is produced, which in a ſhort time gathers ſtrength and ſtability by the impreſſion of exterior objects. Pleaſure and pain not being innate, and being only acquired in the ſame manner as the qualities which we derive from inſtruction, education, and ſociety, it follows that we learn to ſuffer and enjoy as we learn any other ſcience.”

This is ſtrange reaſoning and ſtrange language. That ſenſations are not innate is univerſally acknowledged; but it does not therefore follow that the ſoul receives its firſt impreſſions and firſt ſenſations at the moment of birth. The child has life, the power of locomotion, and the ſenſe of touch, long before it is born; and every mother will tell this philoſopher, that an infant unborn exhibits ſymptoms both of pain and of pleaſure. That many of our organs of ſenſe are improved by uſe is incontrovertible; but it is ſo far from being true that our ſenſible pleaſures become more exquiſite by being often repeated, that the direct contrary is experienced of far the greater part of them; and though external objects, by making repeated impreſſions on the ſenſes, certainly leave deeper traces on the memory than an object once perceived can do, it by no means follows that theſe impreſſions become the more delightful the more familiar that they are to us. That we learn to ſuffer and enjoy as we learn any other ſcience, is a moſt extravagant paradox; for it is ſelf-evident that we cannot live without being capable in ſome degree both of ſuffering and enjoyment, though a man may certainly live to old age in profound ignorance of all the ſciences.

The ſame writer aſſures us, indeed, that ſenſation is not neceſſary to human life. “Philoſophers (ſays he) make mention of a man who had loſt every kind of feeling in every member of his body: he was pinched or pricked to no purpoſe. Meanwhile this man made uſe of all his members; he walked without pain, he drank, ate, and ſlept, without perceiving that he did ſo. Senſible neither to pleaſure nor pain, he was a true natural machine.”

To the tale of theſe anonymous philoſophers our author gives implicit credit, whilſt he favours us at the ſame inſtant with the following argumentation, which completely proves its falſehood. “It is true that ſenſation is a relative quality, ſuſceptible of increaſe and diminution; that it is not neceſſary to exiſtence; and that one might live without it: but in this caſe he would live as an automaton, without feeling pleaſure or pain; and he would poſſeſs neither idea, nor reflection, nor deſire, nor paſſion, nor will, nor ſentiment; his exiſtence would be merely paſſive, he would live without knowing it, and die without apprehenſion.”.

But if this man of the philoſophers, whom our author calls an *automaton*, and a *true natural machine*, had neither *idea*, nor *deſire*, nor *paſſion*, nor *will*, nor *ſentiment* (and without ſenſation he certainly could have none of them), what induced him to *walk*, *eat*, or *drink*, or to *ceaſe* from any of theſe operations after they were accidentally begun: The inſtances of the *automata* which played on the flute and at cheſs are not to the purpoſe for which they are adduced; for there is no parallel between them and this natural machine, unleſs the philoſophers wound up their man to eat, drink, walk, or ſit, as Vacanſon and Kempeler wound up their automata to play or ceaſe from playing on the German flute and at cheſs. See ANDROIDES.

Our author having for a while ſported with theſe harmleſs paradoxes, proceeds to put the credulity of his reader to the teſt with others of a very contrary tendency. He inſtitutes an inquiry concerning the ſuperiority, in number and degree, of the pleaſures enjoyed by the different orders of men in ſociety; and labours, not indeed by argument, but by looſe declamation, to propagate the belief that happineſs is very unequally diſtributed. The pleaſures of the rich, he ſays, muſt be more numerous and exquiſite than thoſe of the poor; the nobleman muſt have more enjoyments than the plebeian of equal wealth; and the king, according to him, muſt be the happieſt of all men. He owns, indeed, that although “birth, rank, honours, and dignity, add to happineſs, a man is not to be conſidered as miſerable becauſe he is born in the lower conditions of life. A man may be happy as a mechanic, a merchant, or a labourer, provided he enters into the ſpirit of his profeſſion, and has not imbibed by a miſplaced education thoſe ſentiments which make his condition inſupportable. Happineſs is of eaſy acquiſition in the middling ſtations of life; and though perhaps we are unable to know or to rate exactly the pleaſure which ariſes from contentment and mediocrity, yet happineſs being a kind of aggregate of delights, of riches, and of advantages more or leſs great, every perſon muſt have a ſhare of it; the diviſion is not exactly made, but all other things equal, there will be more in the elevated than in the inferior conditions of ſociety; the enjoyment will be more felt, the means of enjoying more multiplied, and the pleaſures more varied. Birth, rank, fortune, talents, wit, genius, and virtue, are then the great ſources of happineſs: thoſe advantages are ſo conſiderable, that we ſee men contented with any one of them, but their union forms ſupreme felicity.

“There is ſo vaſt a difference, ſays Voltaire, between a man who has made his fortune and one who has to make it, that they are ſcarcely to be conſidered as creatures of the ſame kind. The ſame thing may be ſaid of birth, the greateſt of all advantages in a large ſociety; of rank, of honours, and of great abilities. How great a difference is made between a perſon of high birth and a tradeſman; between a Newton or Deſcartes and a ſimple mathematician? Ten thouſand ſoldiers are killed on the field of battle, and it is ſcarcely mentioned; but if the general falls, and eſpecially if he be a man of courage and abilities, the court and city are filled with the news of his death, and the mourning is univerſal.

“Frederic the Great, the late king of Pruſſia, felt in a more lively manner than perhaps any other man the value of great talents. I would willingly renounce, ſaid he to Voltaire, every thing which is an object of deſire and ambition to man; but I am certain if I were not a prince I ſhould be nothing. Your merit alone would gain you the eſteem, and envy, and admiration of the world; but to ſecure reſpect for me, titles, and armies, and revenues, are abſolutely neceſſary."

For what purpoſe this account of human happineſs was publiſhed, it becomes not us to ſay. Its obvious tendency is to make the lower orders of ſociety diſcontented with their ſtate, and envious of their ſuperiors; and it is not unreaſonable to ſuppoſe, that it contributed in ſome degree to excite the ignorant part of the author's countrymen to the commiſſion of thoſe atrocities of which they have ſince been guilty. That ſuch was his intention, the following extract will not permit us to believe; for though in it the author attempts to ſupport the ſame falſe theory of human happineſs, he mentions virtuous kings with the reſpect becoming a loyal ſubject of the unfortunate Louis, whoſe character he ſeems to have intentionally drawn, and whoſe death by the authority of a ſavage faction he has in effect foretold.

" Happineſs, in a ſtate of ſociety, takes the moſt variable forms: it it a Proteus ſuſceptible of every kind of metamorphoſis: it is different in different men, in different ages, and in different conditions, &c. The pleaſures of youth are very different from thoſe of old age: what affords enjoyment to a mechanic would be ſupreme miſery to a nobleman; and the amuſements of the country would appear inſipid in the capital. Is there then nothing fixed with regard to happineſs? Is it of all things the moſt variable and the moſt arbitrary? Or, in judging of it, it is impoſſible to find a ſtandard by which we can determine the limits of the greateſt good to which man can arrive in the preſent ſtate? It is evident that men form the ſame ideas of the beautiful and ſublime in nature, and of right and wrong in morality, provided they have arrived at that degree of improvement and civilization of which human nature is ſuſceptible; and that different opinions on theſe ſubjects depend on different degrees of culture, of education, and of improvement. The ſame thing may be advanced with regard to happineſs: all men, if equal with reſpect to their organs, would form the very ſame ideas on this ſubject if they reached the degree of improvement of which we are preſently ſpeaking; and in fact, do we not ſee in the great circles at Rome, at Vienna, at London, and Paris, that thoſe who are called people of faſhion, who have received the ſame education, have nearly the ſame taſte, the ſame deſires, and the ſame ſpirit for enjoyment? there is doubtleſs a certain degree of happineſs to be enjoyed in every condition of life; but as there are ſome conditions preferable to others, ſo are there degrees of happineſs greater and leſs; and if we were to form an idea of the greateſt poſſible in the preſent ſtate, it perhaps would be that of a ſovereign, maſter of a great empire, enjoying good health and a moderate ſpirit; endowed with piety and virtue, whoſe whole life was employed in acts of juſtice and mercy, and who governed by fixed and immoveable laws. Such a king is the image of the divinity on earth, and he muſt be the idol of a wiſe people. His whole life ſhould preſent a picture of the moſt auguſt felicity. Although ſuch ſovereigns are rare, yet we are not without examples of them. Ancient hiſtory affords us Titus and Marcus Aurelius; and the preſent age can boaſt of piety and munificence in the character of ſome of its kings. This ſtate of the greateſt happineſs to which man can reach not being ideal, it will ſerve as a ſtandard of compariſon by which happineſs and miſery can be eſtimated in all civilized countries. *He is as happy as a king*, is a proverbial expreſſion, becauſe we believe with juſtice that royalty is the extreme limit of the greateſt enjoyments; and in fact, happineſs being the work of man, that condition which comprehends all the degrees of power and of glory, which is the ſource of honour and of dignity, and which ſuppoſes in the perſon inveſted with it all means of enjoyment either for himſelf or others, leaves nothing on this earth to which any reaſonable man would give the preference.

" We can find alſo in this high rank the extreme of the greateſt evils to which the condition of nature is expoſed. A king condemned to death, and periſhing on a ſcaffold, by the authority of a faction, while at the ſame time he had endeavoured by every means in his power to promote the general happineſs of his ſubjects, is the moſt terrible and ſtriking example of human miſery; for if it be true that a crown is the greateſt of all bleſſings, then the loſs of it, and at the ſame time the loſs of life by an ignominious and unjuſt ſentence, are of all calamities the moſt dreadful.

" It is alſo in the courts of kings that we find the moſt amiable and perfect characters; and it is there where true grandour, true politeneſs, the beſt tone of manners, the moſt amiable graces, and the moſt eminent virtues, are completely eſtabliſhed. It is in courts that men ſeem to have acquired their greateſt improvement: Whoſoever has ſeen a court, ſays La Bruyere, has ſeen the world in the moſt beautiful, the moſt enchanting, and attractive colours. The prejudices of mankind in behalf of the great are ſo exceſſive, that if they inclined to be good they would be almoſt the objects of adoration."

In this paſſage there are doubtleſs many juſt obſervations; but there is at leaſt an equal number of others both falſe and dangerous. That a crown is the greateſt of earthly bleſſings, and that it is in the courts of kings that we met with the moſt amiable and perfect characters, are poſitions which a true philoſopher will not admit but with great limitations. The falſehood of the author's general theory reſpecting the unequal diſtribution of happineſs in ſociety, we need not waſte time in expoſing. It is ſufficiently expoſed in other articles of this work, and in one of them by a writer of a very ſuperior order. (See HAPPINESS; and *MORAL Philoſophy*, Part II. chap. ii.) He enters upon other ſpeculations reſpecting the pleaſures and pains of ſavages, which are ingenious and worthy of attention; but before we proceed to notice them, it will be proper to conſider the connection which ſubſiſts between pleaſure and pain.

" That the ceſſation of pain is accompanied by pleaſure, is a fact (ſays a philoſopher of the firſt rank †) which has been repeatedly obſerved, but perhaps not ſufficiently accounted for. Let us ſuppoſe a perſon in a ſtate of indifference as to heat. Upon coming near a fire, he will experience at firſt an agreeable warmth, *i. e.* pleaſure. If the heat be increaſed, this ſtate of pleaſure will, after a time, be converted into one of pain, from the increaſed action upon the nerves and brain, the undoubted organs of all bodily ſenſations. Let the heat now be gradually withdrawn, the nervous ſyſtem muſt acquire again, during this removal, the ſtate of agreeable warmth or pleaſure; and after paſſing through that ſtate it will arrive at indifference. From this fact then we may conclude, that a ſtate of pleaſure may be puſhed on till it is converted into one of pain; and, on the other hand, that an action which produces pain will, if it go off gradually, induce at a certain period of its decreaſe a ſtate of pleaſure. The ſame reaſoning which has thus been applied to the body may be extended alſo to the mind. Total languor of mind is not ſo pleaſant as a certain degree of action or emotion; and emotions pleaſant at one period may be increaſed till they become painful at another; whilſt painful emotions, as they gradually expire, will at a certain period of their decreaſe, induce a ſtate of pleaſure. Hence then we are able to explain why pleaſure ſhould ariſe in all caſes from the gradual ceſſation of any action or emotion which produces pain."

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† Dr Sayers

The ſame author maintains, that from the mere removal of pain, whether by degrees or inſtantaneouſly, we always experience pleaſure; and if the pain removed was exquiſite, what he maintains is certainly true. To account for this phenomenon, he lays down the following law of nature, which experience abundantly confirms, viz. "that the temporary withdrawing of any action from the body or mind invariably renders them more ſuſceptible of that action when again produced." Thus, after long faſting, the body is more ſuſceptible of the effects of food than if the ſtomach had been lately ſatisfied; the action of ſtrong liquors is found to be greater on thoſe who uſe them ſeldom than on ſuch as are in the habit of drinking them. Thus, too, with reſpect to the mind; if a perſon be deprived for a time of his friend's ſociety, or of a favourite amuſement, the next viſit of his friend, or the next renewal of his amuſement, is attended with much more pleaſure than if they had never been withheld from him.

"To apply this law to the caſe of a perſon ſuddenly relieved from acute pain. While he labours with ſuch pain, his mind is ſo totally occupied by it, that he is unable to attend to his cuſtomary purſuits or amuſements. He becomes therefore ſo much more ſuſceptible of their action, that when they are again preſented to him he is raiſed above his uſual indifference to poſitive pleaſure. But all pains do not proceed from an exceſs of action. Many of them ariſe from reducing the body or the mind to a ſtate below indifference. Thus, if a perſon have juſt ſufficient warmth in his body to keep him barely at eaſe or in a ſtate of indifference, by withdrawing this heat a ſtate of uneaſineſs or pain is produced; and if in a calm ſtate of mind one be made acquainted with a melancholy event, his quiet is interrupted, and he ſinks below indifference into a painful ſtate of mind. If now, without communicating any new ſource of poſitive pleaſure, we remove in the former caſe the cold, and in the latter the grief, the perſons from whom they are removed will experience real pleaſure. Thus, then, whether pain ariſes from exceſs or deficiency of action, the gradual or the ſudden removal of it muſt be in all caſes attended with pleaſure ‡." It is equally true that the gradual or ſudden removal of pleaſure is attended with pain."

We are now prepared to examine our French author's account of the pleaſures and pains of ſavages. "Every age (ſays he) has its different pleaſures; but if we were to imagine that thoſe of childhood are equal to thoſe of confirmed age, we ſhould be much miſtaken in our eſtimation of happineſs. The pleaſures of philoſophy, either natural or moral, are not unfolded to the infant; the moſt perfect muſic is a vain noiſe; the moſt exquiſite perfumes and diſhes highly ſeaſoned offend his young organs inſtead of affording delight; his touch is imperfect; forty days elapſe before the child gives any ſign of laughter or of weeping; his cries and groans before that period are not accompanied with tears; his countenance expreſſes no paſſion; the parts of his face bear no relation to the ſentiments of the ſoul, and are moreover without conſiſtency. Children are but little affected with cold; whether it be that they feel leſs, or that the interior heat is greater than in adults. In them all the impreſſions of pleaſure and pain are tranſitory; their memory has ſcarcely begun to unfold its powers; they enjoy nothing but the preſent moment; they weep, laugh, and give tones of ſatisfaction without conſciouſneſs, or at leaſt without reflection; their joy is confined to the indulgence of their little whims, and conſtraint is the greateſt of their misfortunes; few things amuſe, and nothing ſatisfies them. In this happy condition of early infancy nature is at the whole expence of happineſs; and the only point is not to contradict her. What deſires have children? Give them liberty in all their movements, and they have a plenitude of exiſtence, an abundance of that kind of happineſs which is confined in ſome ſort to all the objects which ſurround them: but if all beings were happy on the ſame conditions, ſociety would be at no expence in procuring the happineſs of the different individuals who compoſe it. Senſation is the foundation of reflection; it is the principal attribute of the ſoul; it is by this that man is elevated to ſublime ſpeculations, and ſecures his dominion over nature and himſelf. This quality is not ſtationary, but ſuſceptible, like all other relative qualities, of increaſe and decay, of different degrees of ſtrength and intenſeneſs: it is different in different men; and in the ſame man it increaſes from infancy to youth, from youth to confirmed manhood: at this period it ſtops, and gradually declines as we proceed to old age and to ſecond childiſhneſs. Conſidered phyſically, it varies according to age, conſtitution, climate, and food; conſidered in a moral point of view, it takes its different appearances from individual education, and from the habits of ſociety; for man in a ſtate of nature and ſociety, with regard to ſenſation and the unfolding of his powers, may be conſidered as two diſtinct beings: and if one were to make a calculation of pleaſure in the courſe of human life, a man of fortune and capacity enjoys more than ten thouſand ſavages.

"Pleaſure and pain being relative qualities, they may be almoſt annihilated in the moment of vehement paſſion. In the heat of battle, for example, ardent and animated ſpirits have not felt the pain of their wounds; and minds ſtrongly penetrated with ſentiments of religion, enthuſiaſm, and humanity, have ſupported the moſt cruel torments with courage and fortitude. The ſenſibility of ſome perſons is ſo exquiſitely alive, that one can ſcarcely approach them without throwing them into convulſions. Many diſeaſes ſhow the effect of ſenſibility puſhed to an extreme; ſuch as hyſteric affections, certain kinds of madneſs and ſome of thoſe which proceed from poiſon, and from the bite or ſting of certain animals, as the viper and the tarantula. Exceſſive joy or grief, fear and terror, have been known to deſtroy all ſenſation, and occaſion death (A)"

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‡ Diſquiſitions Metaphyſical and Literary.

Having made theſe preliminary obſervations on pleaſure and plain in infancy, and as they are increaſed or diminiſhed by education, and the different conditions of body and mind, our author proceeds to conſider the capability of ſavages to feel pleaſure and pain. "By ſavages he underſtands all the tribes of men who live by hunting and fiſhing, and on thoſe things which the earth yields without cultivation. Thoſe tribes who poſſeſs herds of cattle, and who derive their ſubſiſtence from ſuch poſſeſſions, are not to be conſidered as ſavages, as they have ſome idea of property. Some ſavages are naturally compaſſionate and humane, others are cruel and ſanguinary. Although the phyſical conſtitution of man be everywhere the ſame, yet the varieties of climate, the abundance or ſcarcity of natural productions, have a powerful influence to determine the inclinations. Even the fierceneſs of the tyger is ſoftened under a mild ſky; now nature forms the manners of ſavages juſt as ſociety and civil inſtitutions form the manners of civilized life. In the one caſe climate and food produce almoſt the whole effect; in the other they have ſcarcely any influence. The habits of ſociety every moment contend with nature, and they are almoſt always victorious. The ſavage devotes himſelf to the dominion of his paſſions; the civilized man is employed in reſtraining, in directing, and in modiſying them: ſo much influence have government, laws, ſociety, and the fear of cenſure and puniſhment, over his ſoul.

"It is not to be doubted that ſavages are ſuſceptible both of pleaſure and pain; but are the impreſſions made on their organs as ſenſible, or do they feel pain in the ſame degree with the inhabitants of a civilized country?

"Their enjoyments are ſo limited, that if we confine ourſelves to truth, a few lines will be ſufficient to deſcribe them: our attention muſt therefore be confined to pain, becauſe the manner in which they ſupport misfortune, and even torture, preſents us with a view of character unequalled in the hiſtory of civilized nations. It is not uncommon in civilized countries to ſee men braving death, meeting it with cheerfulneſs, and even not uttering complaints under the torture; but they do not inſult the executioners of public vengeance, and defy pain in order to augment their torments; and thoſe who are condemned by the laws ſuffer the puniſhment with different degrees of fortitude. On thoſe mournful occaſions, the common ranks, of mankind in general die with leſs firmneſs; thoſe, on the other hand, who have received education, and who, by a train of unfortunate events are brought to the ſcaffold, whether it be the fear of being reproached with cowardice, or the conſideration that the ſtroke is inevitable, ſuch men diſcover the expiring ſighs of ſelf-love even in their laſt moments; and thoſe eſpecially of high rank, from their manners and ſentiments, are expected to meet death with magnanimity: but an American ſavage in the moment of puniſhment appears to be more than human; he is a hero of the firſt order who braves his tormentors, who provokes them to employ all their art, and who conſiders as his chief glory to bear the greateſt degree of pain without ſhrinking (See AMERICA, n° 14, 27, 28, 29). The recital of their tortures would appear exaggerated, if it were not atteſted by the beſt authority, and if the ſavage nations among whom thoſe cuſtoms are eſtabliſhed were not ſufficiently known; but the exceſs of the cruelty is not ſo aſtoniſhing as the courage of the victim. The European expoſed to ſufferings of the ſame dreadful nature would rend heaven and earth with his piercing cries and horrible groans; the reward of martyrdom, the proſpect of eternal life, could alone give him fortitude to endure ſuch torments; but the ſavage is not animated with this exalted hope. What ſupports him then in ſcenes of ſo exquiſite ſuffering? The feeling of ſhame, the fear of bringing reproach on his tribe, and giving a ſtain to his fellows never to be wiped away, are the only ſentiments which influence the mind of a ſavage, and which always, preſent to his imagination, animate him, ſupport him, and lend him ſpirit and reſolution. At the ſame time, however powerful thoſe motives may be, they would not be alone ſufficient, if the ſavage felt pain in the ſame degree with the European. Senſibility as we have already obſerved, is increaſed by education; it is influenced by ſociety, manners, laws, and government; climate and food work it into a hundred different ſhapes; and all the phyſical and moral cauſes contribute to increaſe and diminiſh it. The habitual exiſtence of a ſavage would be a ſtate of ſuffering to an inhabitant of Europe. You muſt cut the fleſh of the one and tear it away with your nails, before you can make him feel in an equal degree to a ſcratch or prick of a needle in the other. The ſavage, doubtleſs, ſuffers under torture, but he ſuffers much leſs than an European in the ſame circumſtances: the reaſon is obvious; the air which the ſavages breathe is loaded with fog and moiſt vapours; their rivers not being confined by high banks, are by the winds as well as in floods ſpread over the level fields, and depoſite on them a putrid and pernicious ſlime; the trees ſqueezed one upon another, in that rude uncultivated country ſerve rather as a covering to the earth than an ornament. Inſtead of thoſe freſh and delicious ſhades, thoſe openings in the woods, and walks croſſing

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(A) There are inſtances of perſons who have died at the noiſe of thunder without being touched. A man frighted with the fall of a gallery in which he happened to be, was immediately ſeized with the black jaundice. M. le Cat mentions a young perſon on whom the inſolence of another made ſuch an impreſſion, that his countenance became at firſt yellow, and then changed into black, in ſuch a manner that in leſs than eight days he appeared to wear a maſk of black velvet: he continued in this ſtate for four months without any other ſymptom of bad health or any pain. A ſailor was ſo terrified in a ſtorm, that his face ſweated blood, which like ordinary ſweat returned as it was wiped off. Stahl, whoſe teſtimony cannot be called in queſtion, cites a ſimilar caſe of a girl who had been frightened with ſoldiers. The exceſs of fear, according to many phyſicians, produces madneſs, and epilepſy.

each other in all directions, which delight the traveller in the fine foreſts of France and Germany; thoſe in America ſerve only to intercept the rays of the ſun, and to prevent the benign influence of his beams. The ſavage participates of this cold humidity; his blood has little heat, his humours are groſs, and his conſtitution phlegmatic. To the powerful influence of climate, it is neceſſary to join the habits of his life. Obliged to traverſe vaſt deſerts for ſubſiſtence, his body is accuſtomed to fatigue; food not nouriſhing, and at the ſame time in no great plenty, blunts his feelings; and all the hardſhips of the ſavage ſtate give a rigidity to his members which makes him almoſt incapable of ſuffering. The ſavage in this ſtate of nature may be compared to the water-women and ſtreet-porters, who, though they poſſeſs neither great vigour nor ſtrength, are capable of performing daily, and without complaint, that kind of labour which to a man in a different condition of life would be a painful and grievous burden. Feeling, in leſs perfection with the ſavage, by the effects of climate and food, and the habits of his life, is ſtill farther reſtrained by moral conſiderations. The European is leſs a man of nature than of ſociety: moral reſtraints are powerful with him; while over the American they have ſcarcely any influence. This latter then is in a double condition of imperfection with regard to us; his ſenſes are blunted, and his moral powers are not diſcloſed. Now, pleaſure and pain depending on the perfection of the ſenſes and the unfolding of the intellectual faculties, it cannot be doubted, that in enjoyments of any kind ſavages experience leſs pleaſure, and in their ſuffering leſs pain, than Europeans in the ſame circumſtances. And in fact, the ſavages of America poſſeſs a very feeble conſtitution. They are agile without being ſtrong; and this agility depends more on their habits than on the perfection of their members: they owe it to the neceſſity of hunting; and they are moreover ſo weak, that they were unable to bear the toil which their firſt oppreſſors impoſed on them. Hence a race of men in all reſpects ſo imperfect could not endure torment under which the moſt robuſt European would ſink, if the pain which they feel were really as great as it appears to be. Feeling is then, and muſt neceſſarily be, leſs in the ſavage condition; for this faculty diſcloſing itſelf by the exerciſe of all the phyſical and moral qualities, muſt be leſs as they are leſs exerciſed. Every thing ſhows the imperfection of this precious quality, this ſource of all our affections, in the American ſavages.

"All the improvements in Europe have had a tendency to unfold ſenſibility: the air is purified that we may breathe more freely; the moraſſes are drained, the rivers are regulated in their courſes, the food is nouriſhing, and the houſes commodious. With the ſavages, on the contrary, every thing tends to curb it; they take pleaſure even in hardening the organs of the body, in accuſtoming themſelves to bear by degrees the moſt acute pain without complaining. Boys and girls among the ſavages amuſe themſelves with tying their naked arms together, and laying a kindled coal between them, to try which of them can longeſt ſuffer the heat; and the warriors who aſpire to the honour of being chief, undergo a courſe of ſuffering which exceeds the idea of torture inflicted on the greateſt criminals in Europe."

Theſe obſervations on the pleaſures and pains of ſavages appear to be well-founded, and, as the attentive reader will perceive, are perfectly agreeable to the theory of Dr Sayers. If indeed that theory be juſt, as we believe it to be, it will follow, that the few pleaſures of ſenſe which the American enjoys, he ought to enjoy more completely than any European, becauſe to him they recur but ſeldom. This may very poſſibly be the caſe; and certainly would be ſo, were not his fibres, by climate and the habits of his life, rendered more rigid than thoſe of the civilized part of the inhabitants of Europe. But if we agree with our author § in what he ſays of the pains and pleaſures of ſavages, we cannot admit, without many exceptions, his theory of the enjoyments of children. It is ſo far from being true, that few things amuſe, and that nothing ſatisfies them, that the direct contrary muſt have been obſerved by every man attentive to the operations of the infant mind, which is amuſed with every thing new, and often completely ſatisfied with the mereſt trifle. The pleaſures of philoſophy are not indeed unfolded to the infant; but it by no means follows that he does not enjoy his rattle and his drum as much as the philoſopher enjoys his teleſcope and air-pump; and if there be any truth in the ſcience of phyſiognomy, the happineſs of the former is much more pure and exquiſite than that of the latter. That the moſt perfect muſic is vain noiſe to an infant, is far from being ſelf-evident, unleſs the author confines the ſtate of infancy to a very few months; and we are not diſpoſed to believe, without better proof than we have yet received, that the reliſh of exquiſite perfumes and highly-ſeaſoned diſhes adds much to the ſum of human felicity.

§ Encyclopedie Methodique, Logique, Metaphyſique, et Morale, tom, 4.

But however much we diſapprove of many of theſe reflections, the following we cordially adopt as our own. "If we compare (ſays our author) the pleaſures of ſenſe with thoſe which are purely intellectual, we ſhall find that the latter are infinitely ſuperior to the former, as they may be enjoyed at all times and in every ſituation of life. What are the pleaſures of the table, ſays Cicero, of gaming, and of women, compared with the delights of ſtudy? This taſte increaſes with age, and no happineſs is equal to it. Without knowledge and ſtudy, ſays Cato, life is almoſt the image of death (b). The pleaſures of the ſoul are ſuch, that it is frequent enough to ſee men preſerve their gaiety during their whole life, notwithſtanding a weak, diſeaſed, and debilitated body. Scaron, who lived in the laſt century, was an example of this. Balzac, ſpeaking of him, ſays, that Prometheus, Hercules, and Philoctetes, in profane, and Job in ſacred, hiſtory, ſaid many great things while they were afflicted with violent pain, but Scaron alone ſaid pleaſant things. I have ſeen, continues he, in many places of ancient hiſtory, conſtancy, and modeſty, and wiſdom, and eloquence, accompanying affliction, but he is the only inſtance wherein I have ſeen pleaſantry.

(b) "Savages, barbarians, and peaſants, enjoy little happineſs except that of ſenſation. The happineſs of a civilized and well-informed man conſiſts of ſenſations, of ideas, and of a great number of affinities, altogether unknown to them. He not only enjoys the preſent, but the paſt and the future. He recals the agreeable idea of pleaſures which he has taſted. It is great happineſs, ſays an ancient, to have the recollection of good actions, of an upright intention, and of promiſes which we have kept."

“There are men whoſe underſtandings are conſtantly on the ſtretch, and by this very means they are improved; but if the body were as conſtantly employed in the purſuit of ſenſual gratification, the conſtitution would ſoon be deſtroyed. The more we employ the mind we are capable of the greater exertion; but the more we employ the body we require the greater repoſe. There are beſides but ſome parts of the body capable of enjoying pleaſure; every part of it can experience pain. A toothach occaſions more ſuffering than the moſt conſiderable of our pleaſures can procure of enjoyment. Great pain may continue for any length of time; exceſſive pleaſures are almoſt momentary. Pleaſure carried to an extreme becomes painful; but pain, either by augmenting or diminiſhing it, never becomes agreeable. For the moment, the pleaſures of the ſenſes are perhaps more ſatisfactory; but in point of duration thoſe of the heart and mind are infinitely preferable. All the ſentiments of tenderneſs, of friendſhip, of gratitude, and of generoſity, are ſources of enjoyment for man in a ſtate of civilization. The damned are exceedingly unhappy, ſaid St Catherine de Sienna, if they are incapable of loving or being beloved.

“Pleaſure, continued for a great length of time, produces languor and fatigue, and excites ſleep; the continuation of pain is productive of none of theſe effects. Many ſuffer pain for eight days and even a month without interruption; an equal duration of exceſſive pleaſure would occaſion death.

“Time is a mere relative idea with regard to pleaſure and pain; it appears long when we ſuffer, and ſhort when we enjoy. If there exiſted no regular and uniform movement in nature, we would not be able from our ſenſations alone to meaſure time with any degree of exactneſs, for pain lengthens and pleaſure abridges it. From the languor of unoccupied time has ariſen the proverb expreſſive of our deſire to *kill* it. It is a melancholy reflection, and at the ſame time true, that there is no enjoyment which can effectually ſecure us from pain for the remainder of our lives; while there are examples of evils which hold men in conſtant ſorrow and pain during their whole exiſtence. Such then is the imperfection of the one and the power of the other.

“Pleaſure and pain are the ſources of morality; an action is juſt or unjuſt, good or otherwiſe, only as its natural tendency is to produce ſuffering or enjoyment to mankind. No crime could be committed againſt a being altogether inſenſible, nor could any good be beſtowed on it. Unleſs he were endowed with the deſire of pleaſure and the apprehenſion of pain, man, like an automaton, would act from neceſſity, without choice and without determination.

“All our paſſions are the developement of ſenſibility. If we were not poſſeſſed of feeling, we ſhould be deſtitute of paſſions; and as ſenſibility is augmented by civilization, the paſſions are multiplied; more active and vigorous in an extenſive and civilized empire than in a ſmall ſtate; more in the latter than among barbarous nations; and more in theſe laſt than among ſavages (See Passion). There are more paſſions in France and England than in all the nations of Europe; becauſe every thing which ſerves to excite and foſter them is always in thoſe countries in the greateſt ſtate of fermentation. The mind is active; the ideas great, extenſive, and multiplied. And is it not the ſoul, the mind, and heart, which are the focus of all the paſſions?”

But wherever the paſſions are multiplied, the ſources of pleaſure and pain are multiplied with them. This being the caſe, it is impoſſible to preſcribe a fixed and general rule of happineſs ſuited to every individual. There are objects of pleaſure with regard to which all men of a certain education are agreed; but there are perhaps many more, owing to the variety of tempers and education, about which they differ. Every man forms ideas of enjoyment relative to his character; and what pleaſes one may be utterly deteſted by another. In proportion as a nation is civilized and extenſive, thoſe differences are remarkable. Savages, who are not acquainted with all the variety of pleaſures of civilized nations, amuſe themſelves with very few objects. Owing to the want of civilization, they have ſcarcely any choice in the objects of taſte. They have few paſſions; we have many. But even in civilized nations pleaſure is infinitely varied in its modification and forms. Thoſe differences ariſe from manners, from governments, from political and religious cuſtoms, and chiefly from education. Meanwhile, however different and variable the ideas of pleaſure may be among nations and individuals, it ſtill remains a fact, that a certain number of perſons in all civilized ſtates, whether diſtinguiſhed by birth, or rank, or fortune, or talents, as they have nearly the ſame education ſo they form nearly the ſame ideas of happineſs: but to poſſeſs it, a man muſt give his chief application to the ſtate of his mind; and notwithſtanding all his efforts it is of uncertain duration. Happineſs is the ſunſhine of life: we enjoy it frequently at great intervals; and it is therefore neceſſary to know how to uſe it. All the productions of art periſh; the largeſt fortunes are diſſipated; rank, honour, and dignity paſs away like a fleeting ſhadow; the memory is impaired; all the faculties of the ſoul are extinguiſhed; the body ſinks under the infirmities of old age; and ſcarcely has one reached the boundaries of happineſs marked out by his imagination, when he muſt give place to another, and renounce all his pleaſures, all his hopes, all his illuſions; the fugitive images of which had given happineſs to the mind.

There are pleaſures, however, on which the mind may ſecurely reſt, which elevate man above himſelf, dignify his nature, fix his attention on ſpiritual things, and render him worthy of the care of Providence. Theſe are to be found in true religion; which procures for thoſe who practiſe its duties inexpreſſible happineſs in a better country, and is in this world the ſupport of the weak, and the ſweet conſolation of the unfortunate.

PLEBEIAN, any perſon of the rank of the common people. It is chiefly uſed in ſpeaking of the ancient Romans, who were divided into ſenators, patricians, and plebeians. The diſtinction was made by Romulus the founder of the city; who confined all dignities, civil, military, and ſacerdotal, to the rank of patricians. But to prevent the ſeditions which ſuch a diſtinction might produce through the pride of the higher order and the envy of the lower, he endeavoured to engage them to one another by reciprocal ties and obligations. Every plebeian was allowed to chooſe, out of the body of the patricians, a protector, who ſhould be obliged to aſſiſt him with his intereſt and ſubſtance, and to defend him from oppreſſion. Theſe protectors were called *patrons;* the protected, *clients*. It was the duty of the patron to draw up the contracts of the clients, to extricate them out of their difficulties and perplexities, and to guard their ignorance againſt the artfulneſs of the crafty. On the other hand, if the patron was poor, his clients were obliged to contribute to the portions of his daughters, the payment of his debts, and the ranſom of him and his children if they happened to be taken in war. The client and patron could neither accuſe nor bear witneſs againſt each other; and if either of them was convicted of having violated this law, the crime was equal to that of treaſon, and any one might with impunity ſlay the offender as a victim devoted to Pluto and the infernal gods. For more than 600 years we find no diſſenſions nor jealouſies between the patrons and their clients; not even in the times of the republic, when the people frequently mutinied againſt the great and powerful.

PLECTRANTHUS, in botany: A genus of the gymnoſpermia order, belonging to the didynamia claſs of plants; and in the natural method ranking under the 42d order, *Verticillatæ*. The calyx is monophyllous, ſhort, and bilabiated; the upper lip of which is large, oval, and bent upwards; the inferior lip is quadrifid, and divided into two laciniæ: the corolla is monopetalous, ringent, and turned back; the labiæ look different ways, and from the baſe of the tube there is a nectarium like a ſpur: the filaments are in a declining ſituation, with ſimple antheræ: the ſtylus filiform; the ſtigma bifid. It has four ſeeds covered only by the calyx, There are two ſpecies, viz. 1. The *Fruticoſus*, a native of the Cape of Good Hope; 2. *Punctatus*, a native of Africa. The firſt flowers from June to September, the latter from January to May.

PLEDGE *(Plegius)*, in common law, a ſurety or gage, either real or perſonal, which the plaintiff or demandant is to find for his proſecuting the ſuit.

The word is ſometimes alſo uſed for *Frank Pledge*, which ſee.

To Pledge, in drinking, denotes to warrant, or be ſurety to one, that he ſhall receive no harm while he is taking his draught. The phraſe is referred by our antiquaries to the practice of the Danes, heretofore in England, who frequently uſed to ſtab or cut the throats of the natives while they were drinking.

Pledges of Goods for money. See Pawn.

PLEDGERY, or Pleggery, in law, ſuretiſhip, or an undertaking or anſwering for another.

PLEDGET, Bolster, or *Compreſs*, in ſurgery, a kind of flat tent laid over a wound, to imbibe the ſuperfluous humours, and to keep it clean.

PLEIADES, in fabulous hiſtory, the ſeven daughters of Atlas king of Mauritania and Pleione, were thus called from their mother. They were Maia, Electra, Taygete, Aſterope, Merope, Halcyone, and Celœno; and were alſo called *Atlantides*, from their father Atlas. Theſe princeſſes were carried off by Buſiris king of Egypt; but Hercules having conquered him, delivered them to their father; yet they afterwards ſuffered a new perſecution from Orion, who purſued them five years, till Jove, being prevailed on by their prayers, took them up into the heavens, where they form the conſtellation which bears their name.

Pleiades, in aſtronomy, an aſſemblage of ſeven ſtars, in the neck of the conſtellation Taurus.

They are thus called from the Greek πλειν, *navigare*, "to ſail;" as being terrible to mariners, by reaſon of the rains and ſtorms that frequently riſe with them. The Latins called them *vergiliæ*, from *ver*, "ſpring;" becauſe of their riſing about the time of the vernal equinox. The largeſt is of the third magnitude, and, is called *lucidæ pleiadum*.

PLENARY, ſomething complete or full. Thus we ſay the pope grants *plenary* indulgences; *i. e.* full and entire remiſſions of the penalties due to all ſins. See Indulgences.

PLENIPOTENTIARY, a perſon veſted with full power to do any thing, See Ambassador.

PLENITUDE, the quality of a thing that is full, or that fills another. In medicine, it chiefly denotes a redundancy of blood and humours.

PLENUM, in phyſics, denotes, according to the Carteſians, that ſtate of things wherein every part of ſpace is ſuppoſed to be full of matter, in oppoſition to a Vacuum, which is a ſpace ſuppoſed devoid of all matter.

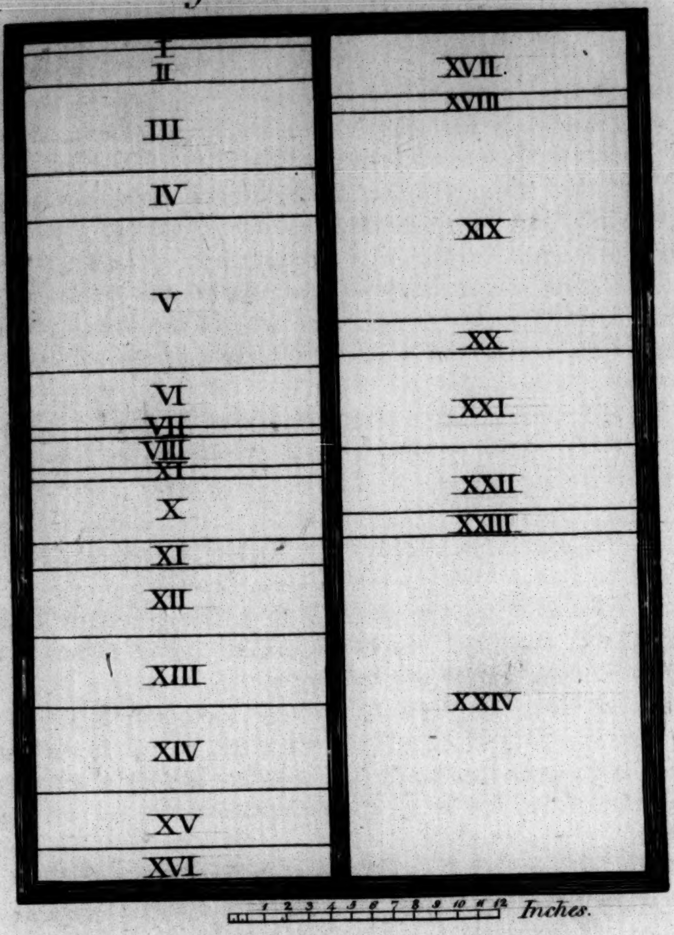
PLENUS flos, a full flower; a term expreſſive of the higheſt degree of luxuriance in flowers. See Botany, p. 428, 2d column. Such flowers, although the moſt delightful to the eye, are both vegetable monſters, and, according to the ſexualiſts, vegetable eunuchs; the unnatural increaſe of the petals conſtituting the firſt; the conſequent excluſion of the ſtamina or male organs, the latter. The following are well known examples of flowers with more petals than one; ranunculus, anemone, marſh-marygold, columbine, fennel-flower, poppy, pæony, pink, gilliflower, campion, viſcous campion, lily, crown imperial, tulip, narciſſus, rocket, mallow, Syrian mallow, apple, pear, peach, cherry, almond, myrtle, roſe, and ſtrawberry.

Flowers with one petal are not ſo ſubject to fullneſs. The following, however, are inſtances: polianthus, hyacinth, primroſe, crocus, meadow-ſaffron, and thorn-apple, tho' Kramer has aſſerted that a full flower with one petal is a contradiction in terms. In flowers with one petal, the mode of luxuriance, or impletion, is by a multiplication of the diviſions of the limb or upper part; in flowers with more petals than one, by a multiplication of the petals or nectarium.

To take a few examples. Columbine is rendered full in three different ways: 1. By the multiplication of its petals, and total excluſion of the nectaria; 2 By the multiplication of the nectaria, and excluſion of the petals; or, 3. By ſuch an increaſe of the nectaria only as does not exclude the petals, between each of which are interjected three nectaria, placed one within another. Again, fennel-flower is rendered full by an increaſe of the nectaria only; narciſſus, either by a multiplication of its cup and petals, or of its cup only; lark-ſpur commonly by an increaſe of the petals and excluſion of the ſpur, which is its nectarium. In *ſaponaria concava anglia*, the impletion is attended with the ſingular effect of incorporating the petals, and reducing their number from five to one; and in gelder-roſe, the luxuriance is effected by an increaſe both in magnitude and number

of

Vegetable Cabinet.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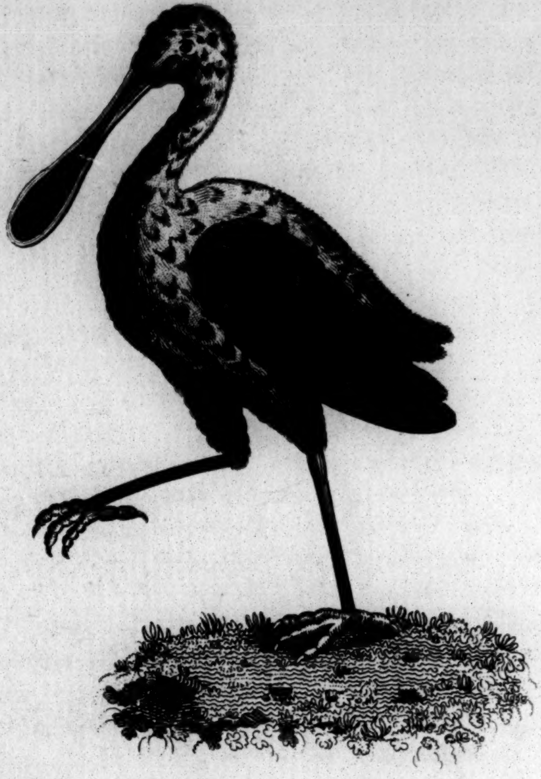
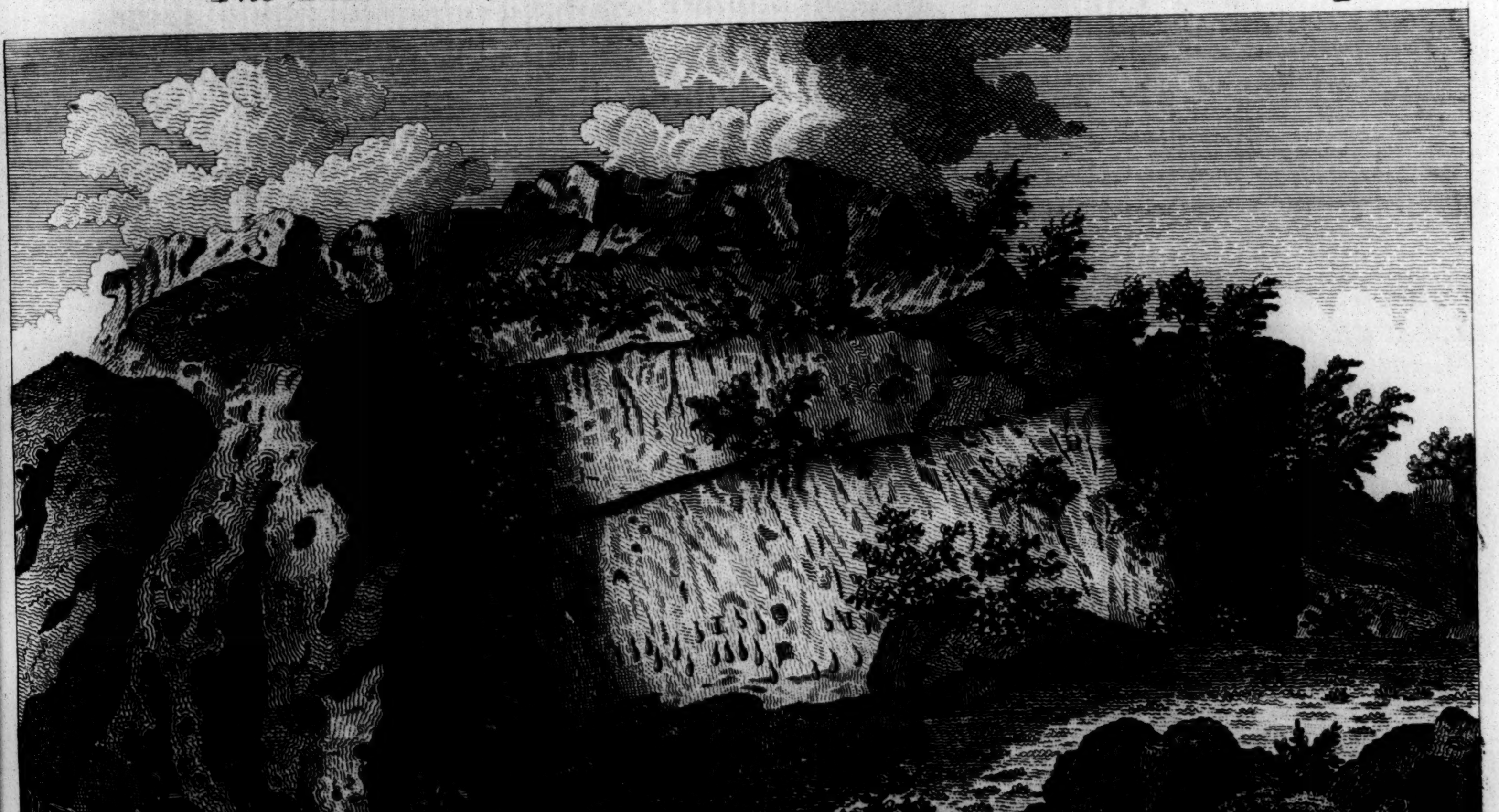
PLATALEA or Spoon Bill.



The MINES of PISSASFALTO in the ISLAND of BUA.



Thackara sc.

BRITISH MUSEUM

of the circumference or margin of the head of flowers, in the plain, wheel-ſhaped, barren florets; and an excluſion of all the bell-ſhaped hermaphrodite florets of the centre or diſk.

Hitherto we have treated of plenitude in ſimple flowers only: the inſtance juſt now adduced ſeems to connect the different modes of impletion in them and compound flowers. Before proceeding farther, however, it will not be improper to premiſe, that as a ſimple luxuriant flower is frequently, by beginners, miſtaken for a compound flower in a natural ſtate, ſuch flowers may always be diſtinguiſhed with certainty by this rule: That in ſimple flowers, however luxuriant, there is but one piſtillum or female organ; whereas in compound flowers, each floret, or partial flower, is furniſhed with its own proper piſtillum. Thus in hawk-weed, a compound flower, each flat or tongue-ſhaped floret in the aggregate has its five ſtamina and naked ſeed, which laſt is in effect its piſtillum; whereas, in a luxuriant lychnis, which is a ſimple flower, there is found only one piſtillum or female organ common to the whole.

In a compound radiated flower, which generally conſiſts of plain florets in the margin or radius, and tubular or hollow florets in the centre or diſc; plenitude is effected either by an increaſe of the florets in the margin, and a total excluſion of thoſe in the diſc; which mode of luxuriance is termed *impletion by the radius*, and reſembles what happens in the gelder-roſe: or by an elongation of the hollow florets in the centre, and a leſs profound diviſion of their brims; which is termed *impletion by the diſc*. In the firſt mode of luxuriance, the florets in the centre, which are always hermaphrodite or male, are entirely excluded; and in their place ſucceed florets ſimilar in ſex to thoſe of the radius. Now, as the florets in the margin of a radiated compound flower are found to be always either female, that is, furniſhed with the piſtillum only; or neuter, that is, furniſhed with neither ſtamina nor piſtillum; it is evident, that a radiated compound flower, filled by the radius, will either be entirely female, as in feverfew, daiſy, and African marigold; or entirely neuter, as in ſunflower, marigold, and centaury: hence it will always be eaſy to diſtinguiſh ſuch a luxuriant flower from a compound flower with plain florets in a natural ſtate; as theſe flowers are all hermaphrodite, that is, furniſhed with both ſtamina and piſtillum. Thus the full flowers of African marigold have each floret furniſhed with the piſtillum or female organ only: the natural flowers of dandelion, which, like the former, is compoſed of plain florets, are furniſhed with both ſtamina and piſtillum.

In the ſecond mode of luxuriance, termed *impletion by the diſc*, the florets in the margin ſometimes remain unchanged: but moſt commonly adopt the figure of thoſe in the centre, without, however, ſuffering any alteration in point of ſex; ſo that confuſion is leſs to be apprehended from this mode of luxuriance than from the former; beſides, the length to which the florets in the centre run out is of itſelf a ſufficient diſtinction, and adapted to excite at once an idea of luxuriance. Daiſy, feverfew, and African marigold, exhibit inſtances of this as well as of the former mode of impletion.

In luxuriant compound flowers with plain florets, the *ſemifloſculoſi* of Tournefort, the ſtigma or ſummit of the ſtyle in each floret is lengthened, and the ſeed-buds are enlarged and diverge; by which characters ſuch flowers may always be diſtinguiſhed from flowers of the ſame kind in a natural ſtate. Scorzonera, nipple-wort, and goat's-beard, furniſh frequent inſtances of the plenitude alluded to.

Laſtly, the impletion of compound flowers with tubular or hollow florets, the *floſculoſi* of Tournefort, ſeems to obſerve the ſame rules as that of radiated flowers juſt delivered. In everlaſting-flower, the *xeranthemum* of Linnæus, the impletion is ſingular, being effected by the enlargement and expanſion of the inward chaffy ſcales of the calyx. Theſe ſcales, which become coloured, are greatly augmented in length, ſo as to overtop the florets, which are ſcarce larger than thoſe of the ſame flower in a natural ſtate. The florets too in the margin, which in the natural flower are female, become, by luxuriance, barren; that is, are deprived of the piſtillum; the ſtyle, which was very ſhort, ſpreads, and is of the length of the chaffy ſcales; and its ſummits, formerly two in number, are metamorphoſed into one.

Full flowers are more eaſily referred to their reſpective genera in methods founded upon the calyx, as the flower-cup generally remains unaffected by this higheſt degree of luxuriance

PLEONASM, a figure in rhetoric, whereby we uſe words ſeemingly ſuperfluous, in order to expreſs a thought with the greater energy; ſuch as, "I ſaw it with my own eyes," &c. See ORATORY, n° 67.

PLESCOW, a town of Ruſſia, capital of a duchy of the ſame name, with an archbiſhop's ſee, and a ſtrong caſtle. It is a large place, and divided into four parts, each of which is ſurrounded with walls. It is ſeated on the river Muldow, where it falls into the lake Pleſcow, 80 miles ſouth of Narva, and 150 ſouth by weſt of Peterſburg. E. Lon. 27. 52. N. Lat. 57. 58.

PLESCOW, a duchy in Ruſſia, between the duchies of Novogorod, Lithuania, Livonia, and Ingria.

PLESSIS-LES-TOURS, a royal palace of France, within half a league of Tours. It was built by Louis XI. and in it he died in the year 1483. It is ſituated in a plain ſurrounded by woods, at a ſmall diſtance from the Loire. The building is yet handſome, though built of brick, and converted to purpoſes of commerce.

PLETHORA, in medicine from πληθος, "plenitude." A plethora is when the veſſels are too much loaded with fluids. The plethora may be ſanguine or ſerous. In the firſt there is too much craſſamentum in the blood, in the latter too little. In the ſanguine plethora, there is danger of a fever, inflammation, apoplexy, rupture of the blood-veſſels, obſtructed ſecretions, &c.: in the ſerous, of a dropſy, &c. A rarefaction of the blood produces all the effects of a plethora; it may accompany a plethora, and ſhould be diſtinguiſhed therefrom. Mr Bromfield obſerves, that a ſanguine plethora may thus be known to be preſent by the pulſe. An artery overchanged with blood is as incapable of producing a ſtrong full pulſe, as one that contains a deficient quantity; in both caſes there will be a low and weak pulſe. To diſtinguiſh rightly, the pulſe muſt not be felt with one or two fingers on the carpal artery; but if three or four fingers cover a conſiderable length of the artery, and we preſs hard for ſome time on it, and then ſuddenly raiſe all theſe fingers except that which is neareſt to the patient's hand, the influx of the blood, if there is a plethora, will be ſo rapid as to raiſe the other finger, and make us ſenſible of the fulneſs. The ſanguine plethora is relieved by bleeding; the ſerous by purging, diuretics, and ſweating. See MEDICINE, n° 100.

PLEURA, in anatomy, a thin membrane covering the inſide of the thorax. See ANATOMY, n° 113.

PLEURITIS, or PLEURISY. See MEDICINE, n° 185.

PLEURONECTES, in ichthyology, a genus belonging to the order of thoracici. Both eyes are on the ſame ſide of the head; there are from four to five rays in the gill-membrane; the body is compreſſed; the one ſide reſembling the back, the other the belly. There are 17 ſpecies; the moſt remarkable are,

1. The hypogloſſus, or holibut. This is the largeſt of the genus: ſome have been taken in European ſeas weighing from 100 to 300 pounds; but much larger are found in thoſe of Newfoundland, Greenland, and Iceland, where they are taken with a hook and line in very deep water. They are part of the food of the Greenlanders, who cut them into large ſlips, and dry them in the ſun. They are common in the London markets, where they are expoſed to ſale cut into large pieces. They are very coarſe eating, excepting the part which adheres to the ſide fins, which is extremely fat and delicious, but ſurfeiting. They are the moſt voracious of all flat fiſh. There have been inſtances of their ſwallowing the lead weight at the end of a line, with which the ſeamen were ſounding the bottom from on board a ſhip. The holibut, in reſpect to its length, is the narroweſt of any of this genus except the ſole. It is perfectly ſmooth, and free from ſpines either above or below. The colour of the upper part is duſky; beneath, of a pure white. We do not count the rays of the fins in this genus; not only becauſe they are ſo numerous, but becauſe nature hath given to each ſpecies characters, independent of theſe rays, ſufficient to diſtinguiſh them by. Theſe flat fiſh ſwim ſidewiſe; for which reaſon Linnæus hath ſtyled them *pleuronectes*.

2. The plateſſa, or plaiſe, are very common on moſt of the Engliſh coaſts, and ſometimes taken of the weight of 15 pounds; but they ſeldom reach that ſize, one of eight or nine pounds being reckoned a large fiſh. The beſt and largeſt are taken off Rye on the coaſt of Suſſex, and alſo off the Dutch coaſts. They ſpawn in the beginning of February. They are very flat, and much more ſquare than the preceding. Behind the left eye is a row of ſix tubercles, that reaches to the commencement of the lateral line. The upper part of the body and fins are of a clear brown, marked with large bright orange-coloured ſpots: the belly is white.

3. The fleſus, or flounder, inhabits every part of the Britiſh ſea and even frequents the rivers at a great diſtance from the ſalt waters; and for this reaſon ſome writers call it the *paſſer fluviatilis*. It never grows large in the rivers, but is reckoned ſweeter than thoſe that live in the ſea. It is inferior in ſize to the plaiſe, ſeldom or never weighing more than ſix pounds. It may very eaſily be diſtinguiſhed from the plaiſe, or any other fiſh of this genus, by a row of ſharp ſmall ſpines that ſurround its upper ſides, and are placed juſt at the junction of the fins with the body. Another row marks the ſide-line, and runs half way down the back. The colour of the upper part of the body is a pale brown, ſometimes marked with a few obſcure ſpots of dirty yellow; the belly is white.

4. The limanda, or dab, is found with the other ſpecies, but is leſs common. It is in beſt ſeaſon during February, March, and April; they ſpawn in May and June, and become flabby and watery the reſt of ſummer. They are ſuperior in quality to the plaiſe and flounder, but far inferior in ſize. It is generally of an uniform brown colour on the upper ſide, though ſometimes clouded with a darker. The ſcales are ſmall and rough, which is a character of this ſpecies. The lateral line is extremely incurvated at the beginning, then goes quite ſtraight to the tail. The lower part of the body is white.

5. The ſolea, or ſole, is found on all the Engliſh coaſts; but thoſe on the weſtern ſhores are much ſuperior in ſize to thoſe on the north. On the former they are ſometimes taken of the weight of ſix or ſeven pounds, but towards Scarborough they rarely exceed one pound; if they reach two, it is extremely uncommon. They are uſually taken in the trawl-net: they keep much at the bottom, and feed on ſmall ſhell-fiſh. It is of a form much more narrow and oblong than any other of the genus. The irides are yellow; the pupils of a bright ſapphirine colour: the ſcales are ſmall, and very rough: the upper part of the body is of a deep brown; the tip of one of the pectoral fins black; the under part of the body white; the lateral line is ſtraight; the tail rounded at the end. It is a fiſh of a very delicate flavour; but the ſmall ſoles are in this reſpect much ſuperior to large ones. By the ancient laws of the Cinque Ports, no one was to take ſoles from the 1ſt of November to the 15th of March; neither was any body to fiſh from ſun-ſetting to ſun-riſing, that the fiſh might enjoy their night-food. The chief fiſhery for them is at Brixham in Torbay.

6. The maximus, or turbot, grows to very large ſize: Mr Pennant has ſeen them of 23 pounds weight, but has heard of ſome that weighed 30. The turbot is of a remarkable ſquare form: the colour of the upper part of the body is cinereous, marked with numbers of black ſpots of different ſizes: the belly is white; the ſkin is without ſcales, but greatly wrinkled, and mixed with ſmall ſhort ſpines, diſperſed without any order.—Theſe fiſh are taken chiefly off the north coaſt of England, and others off the Dutch coaſt. See *Turbot* FISHERY.

PLEURS, a town in France, which was buried under a mountain in the year 1618. See our article MOUNTAIN, p. 430. Of this fatal circumſtance, Biſhop Burnet, in his Travels, p. 96. gives the following account. "Having mentioned (ſays the Biſhop) ſome falls of mountains in theſe parts (viz. near the Alps), I cannot paſs by the extraordinary fate of the town of Pleurs, about a league from Chavennes to the north.—The town was half the bigneſs of Chavennes, but much more nobly built; for, beſides the great palace of the Francken, that coſt ſome millions, there were many other palaces built by rich factors both of Milan and the other parts of Italy, who, liking the ſituation and air, as well as the freedom of the government, gave themſelves all the indulgences that a vaſt wealth could furniſh. By one of the palaces that was a little diſtant from the town, and was not overwhelmed with it, one may judge of the reſt. It was an out-houſe of the family of the Francken, and yet it may compare with many palaces in Italy. The voluptuouſneſs of this place became

came very crying; and Madam de Salis told me that ſhe heard her mother often relate ſome paſſages of a Proteſtant miniſter's ſermons that preached in a little church there who warned them often of the terrible judgments of God which were hanging over their heads, and which he believed would ſuddenly break out upon them.

"On the 25th of Auguſt 1628, an inhabitant came and told them to be gone, for he ſaw the mountains cleaving; but he was laughed at for his pains. He had a daughter whom he perſuaded to leave all and go with him; but when ſhe was ſafe out of town, ſhe called to mind that ſhe had not locked the door of a room in which ſhe had ſome things of value, and ſo ſhe went back to do that, and was buried with the reſt; for at the hour of ſupper the hill fell down, and buried the town and all the inhabitants, to the number of 2200, ſo that not one perſon eſcaped. The fall of the mountains did ſo fill the channel of the river, that the firſt news thoſe of Chavennes had of it was by the failing of their river; for three or four hours there came not a drop of water, but the river wrought for itſelf a new courſe, and returned to them.

"I could hear no particular character of the man who eſcaped (continues the Biſhop); ſo I muſt leave the ſecret reaſon of ſo ſingular a preſervation to the great diſcovery, at the laſt day, of thoſe ſteps of Divine Providence that are now ſo unaccountable. Some of the family of the Francken got ſome miners to work under ground, to find out the wealth that was buried in their houſe; for, beſides their plate and furniture, there was a great deal of caſh and many jewels in the houſe. The miners pretended they could find nothing; but they went to their country of Tirol, and built fine houſes, and a great wealth appeared, of which no other viſible account could be given but this, that they had found ſome of that treaſure."

PLEXUS, among anatomiſts, a bundle of ſmall veſſels interwoven, in the form of net-work: thus a congeries of veſſels within the brain is called *plexus choroides, reticularis,* or *retiformis.* See ANATOMY, n° 136.

A plexus of nerves is an union of two or more nerves, forming a ſort of ganglion or knot.

PLICA POLONICA, or *plaited hair,* is a diſeaſe peculiar to Poland; whence the name. See MEDICINE, n° 335. Mr Coxe, who gives a ſhort account of it, attempts likewiſe to give the phyſical cauſes of it. Many cauſes of this kind, he tells us, have been ſuppoſed to concur in rendering the plica more frequent in thoſe regions than in other parts. It would be an endleſs work to enumerate the various conjectures with which each perſon has ſupported his favourite hypotheſis.—The moſt probable are thoſe aſſigned by Dr Vicat: The firſt cauſe is the nature of the Poliſh air, which is rendered inſalubrious by numerous woods and moraſſes, and occaſionally derives an uncommon keenneſs even in the midſt of ſummer from the poſition of the Carpathian mountains; for the ſouthern and ſouth-eaſterly winds, which uſually convey warmth in other regions, are in this chilled in their paſſage over their ſnowy ſummits. The ſecond is, unwholeſome water; for although Poland is not deficient in good ſprings, yet the common people uſually drink that which is neareſt at hand, taken indiſcriminately from rivers, lakes, and even ſtagnant pools. The third cauſe is the groſs inattention of the natives to cleanlineſs; for experience ſhows, that thoſe who are not negligent in their perſons and habitations, are leſs liable to be afflicted with the plica than others who are deficient in that particular. Thus perſons of higher rank are leſs ſubject to this diſorder than thoſe of inferior ſtations; the inhabitants of large towns than thoſe of ſmall villages; the free peaſants than thoſe in an abſolute ſtate of vaſſalage; the natives of Poland Proper than thoſe of Lithuania. Whatever we may determine as to the poſſibility that all or any of theſe cauſes, by themſelves, or in conjunction with others, originally produced the diſorder; we may venture to aſſert, that they all, and particularly the laſt, aſſiſt its propagation, inflame its ſymptoms, and protract its cure.

In a word, the plica polonica appears to be a contagious diſtemper; which, like the leproſy, ſtill prevails among a people ignorant in medicine, and inattentive to check its progreſs, but is rarely known in thoſe countries where proper precautions are taken to prevent its ſpreading.

PLIMPTON, a town of Devonſhire, in England, with a market on Saturdays. It is ſeated on a branch of the river Plime, and had once a caſtle, now in ruins. It ſends two members to parliament; is ſeven miles E. of Plymouth, and 218 W. by S. of London. W. Long. 4. 0. N. Lat. 50. 32.

PLINIA, in botany; a genus of plants of the polyandria monogynia claſs, deſcribed by Plumier and Linnæus. The empalement is divided into five ſegments; the flower conſiſts of five petals; the ſtamina are numerous filaments, ſlender, and as long as the flower; the antheræ are ſmall, and ſo is the germen of the piſtil; the ſtyle is ſubulated, and of the length of the ſtamina; the ſtigma is ſimple; the fruit is a large globoſe berry, of a ſtriated or ſulcated ſurface, containing only one cell, in which is a very large, ſmooth, and globoſe ſeed. There is only one ſpecies.

PLINTH, ORLE, or *Orlo,* in architecture, a flat ſquare member, in the form of a brick. It is uſed as the foundation of columns, being that flat ſquare table under the moulding of the baſe and pedeſtal at the bottom of the whole order. It ſeems to have been originally intended to keep the bottom of the original wooden pillars from rotting. Vitruvius alſo calls the Tuſcan abacus *plinth.*

PLINTH of a Statue, &c. is a baſe, either flat, round, or ſquare, that ſerves to ſupport it.

PLINTH of a Wall, denotes two or three rows of bricks advancing out from a wall; or, in general, any flat high moulding, that ſerves in a front-wall to mark the floors, to ſuſtain the caves of a wall, or the larmier of a chimney.

PLINY the ELDER, or *Cæcilius Plinius Secundus,* one of the moſt learned men of ancient Rome, was deſcended from an illuſtrious family, and born at Verona. He bore arms in a diſtinguiſhed poſt; was one of the college of Augurs; became intendant of Spain; and was employed in ſeveral important affairs by Veſpaſian and Titus, who honoured him with their eſteem. The eruption of Mount Veſuvius, which happened in the year 79, proved fatal to him. His nephew, Pliny the Younger, relates the circumſtances of that dreadful eruption, and the death of his uncle, in a letter to Tacitus. Pliny the Elder wrote a Natural Hiſtory in 37 books, which is ſtill extant, and has had many editions; the moſt eſteemed of which is that of Father Harduin, printed at Paris in 1723, in two volumes folio.

Pliny the Younger, nephew of the former, was born in the ninth year of Nero, and the 62d of Chriſt, at Novocomum, a town upon the lake Larius, near which he had ſeveral beautiful villas. Cæcilius was the name of his father, and Plinius Secundus that of his mother's brother, who adopted him. He brought into the world with him fine parts and an elegant taſte, which he did not fail to cultivate early; for as he tells us himſelf, he wrote a Greek tragedy at 14 years of age. He loſt his father when he was young; and had the famous Virginius for his tutor or guardian, whom he has ſet in a glorious light. He frequented the ſchools of the rhetoricians, and heard Quintilian; for whom he ever after entertained ſo high an eſteem, that he beſtowed a conſiderable portion upon his daughter at her marriage. He was in his 18th year when his uncle died; and it was then that he began to plead in the forum, which was the uſual road to dignities. About a year after, he aſſumed the military character, and went into Syria with the commiſſion of tribune; but this did not ſuit his taſte any more than it had done Tully's; and therefore we find him returning after a campaign or two. He tells us, that in his paſſage homewards he was detained by contrary winds at the iſland Icaria, and how he employed himſelf in making verſes: he enlarges in the ſame place upon his poetical exercitations; yet poetry was not the ſhining part of his character any more than it had been of Tully's.

Upon his return from Syria, he married a wife, and ſettled at Rome: it was in the reign of Domitian. During this moſt perilous time, he continued to plead in the forum, where he was diſtinguiſhed not more by his uncommon abilities and eloquence, than by his great reſolution and courage, which enabled him to ſpeak boldly, when ſcarcely one elſe durſt ſpeak at all. On theſe accounts he was often ſingled out by the ſenate to defend the plundered provinces againſt their oppreſſive governors, and to manage other cauſes of a like important and dangerous nature. One of theſe was for the province of Bœotica, in their proſecution of Bæbius Maſſa; in which he acquired ſo general an applauſe, that the emperor Nerva, then a private man, and in baniſhment at Tarentum, wrote to him a letter, in which he congratulated not only Pliny, but the age which had produced an example ſo much in the ſpirit of the ancients. Pliny relates this affair in a latter to Cornelius Tacitus; and he was ſo pleaſed with it himſelf, that he could not help intreating this friend to record it in his hiſtory. He intreats him, however, with infinitely more modeſty than Tully had intreated Lucceius upon the ſame occaſion: and though he might imitate Cicero in the requeſt, as he profeſſes to have conſtantly ſet that great man before him for a model, yet he took care not to tranſgreſs the bounds of decency in his manner of making it. He obtained the offices of queſtor, and tribune, and luckily went unhurt through the reign of Domitian: there is, however, reaſon to ſuppoſe, if that emperor had not died juſt as he did, that Pliny would have ſhared the fate of many other great men; for he tells us himſelf, that his name was afterwards found in Domitian's tablets, among the number of thoſe who were deſtined to deſtruction.

He loſt his wife in the beginning of Nerva's reign, and ſoon after married his beloved Calphurnia, of whom we read ſo much in his Epiſtles. He had not, however, any children by any of his wives: and hence we find him thanking Trajan for the *jus trium liberorum*, which he afterwards obtained of that emperor for his friend Suetonius Tranquillus. He hints alſo, in his letter of thanks to Trajan, that he had been twice married in the reign of Domitian. He was promoted to the conſulate by Trajan in the year 100, where he was 38 years of age; and in this office pronounced that famous panegyric, which has ever ſince been admired, as well for the copiouſneſs of the topics as the elegance of addreſs. Then he was elected augur, and afterwards made proconſul of Bithynia; whence he wrote to Trajan that curious letter concerning the primitive Chriſtians; which, with Trajan's reſcript, is happily extant among his Epiſtles. Pliny's letter, as Mr Melmoth obſerves in a note upon the paſſage, is eſteemed as almoſt the only genuine monument of eccleſiaſtical antiquity relating to the times immediately ſucceeding the apoſtles, it being written at moſt not above 40 years after the death of St Paul. It was preſerved by the Chriſtians themſelves, as a clear and unſuſpicious evidence of the purity of their doctrines, and is frequently appealed to by the early writers of the church againſt the calumnies of their adverſaries. It is not known what became of Pliny after his return from Bithynia; whether he lived at Rome, or what time he ſpent at his country-houſes. Antiquity is alſo ſilent as to the time of his death: but it is conjectured that he died either a little before or ſoon after that excellent prince, his admired Trajan; that is, about the year of Chriſt 116.

Pliny was one of the greateſt wits, and one of the worthieſt men, among the ancients. He had fine parts, which he cultivated to the utmoſt; and he accompliſhed himſelf with all the various kinds of knowledge which could ſerve to make him either uſeful or agreeable. He wrote and publiſhed a great number of things; but nothing has eſcaped the wreck of time except the books of Letters, and the panegyric upon Trajan. This has ever been conſidered as a maſterpiece; and if he has, as ſome think, almoſt exhauſted all the ideas of perfection in a prince, and gone perhaps a little beyond the truth, yet it is allowed that no panegyriſt was ever poſſeſſed of a finer ſubject, and on which he might better indulge in all the flow of eloquence, without incurring the ſuſpicion of flattery and lies. His letters ſeem to have been intended for the public; and in them he may be conſidered as writing his own memoirs. Every epiſtle is a kind of hiſtorical ſketch, wherein we have a view of him in ſome ſtriking attitude, either of active or contemplative life. In them are preſerved anecdotes of many eminent perſons, whoſe works are come down to us, as Suetonius, Silius Italicus, Martial, Tacitus, and Quintilian; and of curious things, which throw great light upon the hiſtory of thoſe times. They are written with great politeneſs and ſpirit; and if they abound too much in turn and metaphor, we muſt impute it to that degeneracy of taſte which was then accompanying the degenerate manners of Rome. Pliny, however, ſeems to have preſerved himſelf in this latter reſpect from the general contagion: whatever the manners of the Romans were, his were pure and incorrupt. His writings breathe a ſpirit of tranſcendent goodneſs and humanity: his only imperfection is, he was too deſirous that the public and poſterity ſhould know how humane and good he was. We have two elegant Engliſh tranſlations of his Epiſtles; the one by Mr Melmoth, and the other by Lord Orrery.

PLOCAMA, in botany; a genus of the monogynia order, belonging to the pentandria claſs of plants. The calyx is quinquedentate; the fruit a berry and trilocular, with ſolitary ſeeds. Of this there is only one ſpecies, viz. the *pendula*, a native of the Canaries.

PLOCE. See ORATORY, p. 433.

PLOCKSKO, a town of Poland, and capital of a palatinate of the ſame name, with a caſtle and a biſhop's ſee. The churches are very magnificent; and it is built upon a hill, whence there is a fine proſpect every way, near the river Viſtula. It is 25 miles ſouth-eaſt of Uladiſlaw, and 65 weſt of Warſaw. E. Long. 19. 29. N. Lat. 52. 46.

PLOCKSKO, a palatinate of Poland, bounded on the north by Regal Pruſſia, on the eaſt by the palatinate of Mazovia, on the ſouth by the Viſtula, and on the weſt by the palatinate of Inovladiſlaw. The capital town is of the ſame name.

PLOEN is a town of Germany, in the circle of Lower Saxony, and capital of Holſtein. It ſtands on the banks of a lake of the ſame name, and gave title to a duke, till by the death of the laſt duke Charles without male iſſue it eſcheated to the king of Denmark in 1761. The ducal palace, riſing in the midſt of the town, on an elevated ſpot of ground, and overlooking the lake, is a very pictureſque object. The town ſtands 22 miles north-weſt of Lubeck, and 10 ſouth-eaſt of Kiell. E. Long. 10. 30. N. Lat. 54. 11.

PLOMO, in metallurgy, is a name given by the Spaniards, who have the care of the ſilver-mines, to the ſilver ore, when found adhering to the ſurface of ſtones, and when it incruſts their cracks and cavities like ſmall and looſe grains of gun-powder. Though theſe grains be few in number, and the reſt of the ſtone have no ſilver in it, yet they are always very happy when they find it, as it is a certain token that there is a rich vein ſomewhere in the neighbourhood. And if in digging forwards they ſtill meet with theſe grains, or the plomo in greater quantity, it is a certain ſign that they are getting more and more near the good vein.

PLOT (Dr Robert), a learned antiquarian and philoſopher, was born at Sutton barn, in the pariſh of Borden in Kent, in the year 1641, and ſtudied in Magdalen-hall, and afterwards in Univerſity-college, Oxford. In 1682 he was elected ſecretary of the Royal Society, and publiſhed the Philoſophical Tranſactions from nº 143 to nº 166 incluſive. The next year Elias Aſhmole, Eſq; appointed him firſt keeper of his muſeum, and about the ſame time the vice-chancellor nominated him firſt profeſſor of chemiſtry in the univerſity of Oxford. In 1687 he was made ſecretary to the Earl Marſhal, and the following year received the title of *Hiſtoriographer* to King James II. In 1690 he reſigned his profeſſorſhip of chemiſtry and likewiſe his place of keeper of the muſeum, to which he preſented a very large collection of natural curioſities; which were thoſe he had deſcribed in his hiſtories of Oxfordſhire and Staffordſhire: the former publiſhed at Oxford in 1677, folio, and reprinted with additions and corrections in 1705; and the latter was printed in the ſame ſize in 1686. In January 1694-5, Henry Howard, Earl Marſhal, nominated him Mobray-herald extraordinary; two days after which he was conſtituted regiſter of the court of honour; and, on the 30th of April 1696, he died of the ſtone at his houſe in Borden.

As Dr Plot delighted in natural hiſtory, the above works were deſigned as eſſays towards a Natural Hiſtory of England; and he had actually formed a deſign of travelling through England and Wales for that purpoſe. He accordingly drew up a plan of his ſcheme in a letter to the learned Biſhop Fell, which is inſerted at the end of the ſecond volume of Leland's Itinerary, of the edition of 1744. Amongſt ſeveral MSS. which he left behind him were large materials for the "Natural Hiſtory of Kent, Middleſex, and the city of London." Beſides the above works, he publiſhed *De origine fontium tentamen philoſophicum*, 8vo, and nine papers in the Philoſophical Tranſactions.

PLOT, in dramatic poetry, is ſometimes uſed for the fable of a tragedy or comedy; but more properly for the knot or intrigue, which makes the *embarras* of any piece. See POETRY.

PLOT, in ſurveying, the plan or draught of any field, farm, or manor, ſurveyed with an inſtrument, and laid down in the proper figure and dimenſions.

PLOTINUS, a Platonic philoſopher in the third century. He was born at Lycopolis, a city of Egypt, in 204; and began very early to ſhow a great ſingularity both in his taſte and manners: for at eight years of age, when he went to ſchool, he uſed to run to his nurſe, and uncover her breaſt to ſuck; and would have continued that practice longer, if he had not been diſcouraged by her. At 28 years of age he had a ſtrong deſire to ſtudy philoſophy, on which occaſion he was recommended to the moſt famous profeſſors of Alexandria. He was not ſatisfied with their lectures; but, upon hearing thoſe of Ammonius, he confeſſed that this was the man he wanted. He ſtudied for 11 years under that excellent maſter, and then went to hear the Perſian and Indian philoſophers: for in 243, when the emperor Gordianus intended to wage war againſt the Perſians, he followed the Roman army, but probably repented of it; for it was with difficulty he could ſave his life by flight, after the emperor had been ſlain. He was then 39; and the year following he went to Rome, and read philoſophical lectures in that city; but avoided following the example of Erennius and Origen, his fellow-pupils, who, having promiſed with him not to reveal ſome hidden and excellent doctrines they had received from Ammonius, had nevertheleſs forfeited their word. Plotinus continued ten years in Rome, without writing any thing; but, in his 50th year, Porphyry became his ſcholar; who, being of an exquiſitely fine genius, was not ſatisfied with ſuperficial anſwers, but required to have all difficulties thoroughly explained; and therefore Plotinus, to treat things with greater accuracy, was obliged to write more books. He had before written 21 books and during the ſix years of Porphyry's ſtay with him he wrote 24, and 9 after Porphyry's leaving Rome, in all 54. The Romans had a high veneration for him; and he paſſed for a man of ſuch judg-

Plotinus.

ment and virtue, that many perſons of both ſexes, when they found themſelves dying, intruſted him, as a kind of guardian angel, with the care of their eſtates and children. He was the arbiter of numberleſs laws-ſuits; and conſtanly behaved with ſuch humanity and rectitude of mind, that he did not create himſelf one enemy during the 26 years he reſided in Rome. He, however, did not meet with the ſame juſtice from all of his own profeſſion; for Olympias a philoſopher of Alexandria, being envious of his glory, uſed his utmoſt endeavours, though in vain, to ruin him. The emperor Gallienus, and the empreſs Salonina, had a very high regard for him; and, had it not been for the oppoſition of ſome jealous courtiers, they would have had the city of Campania rebuilt, and given to him with the territory belonging to it, to eſtabliſh a colony of philoſophers, and to have it governed by the ideal laws of Plato's commonwealth. He laboured under various diſorders during the laſt year of his life, which obliged him to leave Rome, when he was carried to Campania to the heirs of one of his friends, who furniſhed him with every thing neceſſary; and he died there in the year 270, at the age of 66, and in the nobleſt manner that an heathen philoſopher could do, theſe being his words as he breathed his laſt: "I am labouring with all my might to return the divine part of me to that Divine Whole which fills the univerſe."

We have already remarked that the ideas of Plotinus were ſingular and extraordinary; and we ſhall now ſhow that they were ſo. He was aſhamed of being lodged in a body, for which reaſon he did not care to tell the place of his birth or family. The contempt he had for all earthly things, was the reaſon why he would not permit his picture to be drawn: and when his diſciple Amelius was urgent with him upon this head, "Is it not enough (ſaid he) to drag after us, whitherſoever we go, that image in which nature has ſhut us up? Do you think that we ſhould likewiſe tranſmit to future ages an image of that image, as a ſight worthy of their attention?" From the ſame principle, he refuſed to attend to his health; for he never made uſe of preſervatives or baths, and did not even eat the fleſh of tame animals. He eat but little, and abſtained very often from bread; which joined to his intenſe meditation, kept him very much from ſleeping. In ſhort, he thought the body altogether below his notice; and had ſo little reſpect for it, that he conſidered it as a priſon, from which it would be his ſupreme happineſs to be freed. When Amelius, after his death inquired about the ſtate of his ſoul of the oracle of Apollo, he was told, "that it was gone to the aſſembly of the bleſſed, where charity, joy, and a love of the union with God prevail:" and the reaſon given for it, as related by Porphyry, is, "that Plotinus had been peaceable, gracious, and vigilant; that he had perpetually elevated his ſpotleſs ſoul to God; that he had loved God with his whole heart; that he had diſengaged himſelf, to the utmoſt of his abilities, from this wretched life; that, elevating himſelf with all the powers of his ſoul, and by the ſeveral gradations taught by Plato, towards that Supreme Being which fills the univerſe he had been enlightened by him; had enjoyed the viſion of him without the help or interpoſition of ideas; had, in ſhort, been often united to him." This is the account of Porphyry, who tells us alſo, that he himſelf had once been favoured with the viſion. To this account, however, we need ſcarcely add, that little credit is due: it agrees pretty much with modern enthuſiaſm and the reveries of Behmeniſts. Plotinus had alſo his familiar ſpirit, as well as Socrates: but, according to Porphyry, it was not one of thoſe called *demons*, but of the order of thoſe who are called *gods*; ſo that he was under the protection of a genius ſuperior to that of other men. The ſuperiority of his genius puffed him up not a little: for when Amelius deſired him to ſhare in the ſacrifices, which he uſed to offer up on ſolemn feſtivals, "It is their buſineſs (replied Plotinus) to come to me, not mine to go to them:" "which lofty anſwer (ſays Porphyry) no one could gueſs the reaſon of, or dared to aſk."

Plotinus, Plotus.

Porphyry put the 54 books of Plotinus in order, and divided them into ſix enneaſes. The greater part of them turn on the moſt high-flown ideas in metaphyſics; and this philoſopher ſeems, in certain points, not to differ much from Spinoza. He wrote two books to prove, that "all being is one and the ſame;" which is the very doctrine of Spinoza. He inquires, in another book, "Whether there are many ſouls, or only one?" His manner of compoſing partook of the ſingularity of his nature: he never read over his compoſitions after he had written them; he wrote a bad hand, and was not exact in his orthography: he ſtood in need, therefore, of a faithful friend to reviſe and correct his writings; and he choſe Porphyry for this purpoſe before Amelius, who had, however, been his diſciple 24 years, and was very much eſtemed by him. Some have accuſed Plotinus of plagiariſm, with regard to Numenius; a ſlander which Amelius refuted. Longinus was once much prejudiced againſt our great philoſopher, and wrote againſt his Treatiſe of Ideas, and againſt Porphyry's anſwer in defence of that treatiſe. He afterwards conceived a high eſteem for him; ſought induſtriouſly for all his books; and, in order to have them very correct, deſired Porphyry to lend him his copy; but at the ſame time wrote to him in the following manner: "I always obſerved to you, when we were together, when we were at a diſtance from one another, as well as when you lived at Tyre, that I did not comprehend many of the ſubjects treated of by Plotinus; but that I was extremely fond of his manner of writing, the variety of his knowledge, and the order and diſpoſition of his queſtions, which are altogether philoſophical." "This ſingle paſſage (ſays Bayle) ſhows the exalted gennius, the exquiſite diſcernment, and judicious penetration of Longinus. It cannot be denied, that moſt ſubjects which this philoſopher examines are incomprehenſible, nevertheleſs, we diſcover in his works a very elevated, fruitful and capacious genius, and a cloſe way of reaſoning. Had Longinus been an injudicious critic, had he not poſſeſſed an exalted and beautiful genius, he would not have been ſo ſenſible of Plotinus's obſcurity: for no perſons complain leſs of the obſcurity of a book, than thoſe whoſe thoughts are confuſed and underſtanding is ſhallow." Marſilius Ficinus, at the requeſt of Coſmo de Medicis, made a Latin verſion of the works of Plotinus, with a ſummary and analyſis of each book; which was printed at Baſil, firſt by itſelf, in 1559, and afterwards with the Greek in 1580, folio. His life was written by Porphyry, the moſt illuſtrious of his diſciples.

PLOTUS, or DARTER, in ornithology, a genus of birds belonging to the order palmipedes. The bill is long and ſharp-pointed; the noſtrils are merely a long ſlit placed near the baſe; the face and chin are bare of feathers; the neck is very long; and the legs are ſhort. They have four toes webbed together. There are three ſpecies of this genus, and three varieties of the ſecond of theſe.

1. The plotus anhinga, or white-bellied darter, is not quite ſo big as a mallard; but its length from the point of the bill to the end of the tail is 10 inches. The bill, which is three inches long, is ſtraight and pointed: the colour is greyiſh, with a yellowiſh baſe: the irides are of a gold colour: the head is ſmall: the neck long and ſlender: the upper part of the back and ſcapulars are of a duſky black colour: the middle of the feathers are daſhed with white: the lower part of the back, &c. are of a fine black colour: the under parts from the breaſts are ſilvery white: the ſmaller wing coverts, and thoſe in the middle, are duſky black; the larger ones are ſpotted with white, and the outer ones are plain black: the tail feathers are 12 in number, broad, long, and gloſſy black: the legs and toes are of a yellowiſh grey. This ſpecies is an inhabitant of Braſil, and is exceedingly expert and cunning in catching fiſh. Like the corvorant, it builds neſts on trees, and rooſts in them at night. It is ſcarcely ever ſeen on the ground, being always on the higheſt branches of trees on the water, or ſuch as grow in the moiſt ſavannas or river ſides. When at reſt, it generally ſits with the neck drawn in between the ſhoulders like the heron. The fleſh is in general very fat; but has an oily, rank, and diſagreeable taſte like that of a gull.

2. The anhinga of Cayenne, or black-bellied anhinga, is as large as a common duck, with a very long neck, and a long ſharp-pointed ſtraight bill. The upper part of the bill is of a pale blue, and the lower is reddiſh: the eyes are very piercing: the head, neck, and upper part of the breaſt are light brown: both ſides of the head, and the upper part of the neck, are marked with a broad white line: the back, ſcapulars, and wing coverts, are marked with black and white ſtripes lengthwiſe in equal portions: the quill feathers, the belly, thighs, and tail, are of a deep black colour; the tail is very long and ſlender: the legs and feet are of a pale green colour; and the four toes, like thoſe of the corvorant, are united by webs. This ſpecies is found in the iſlands of Ceylon and Java. They generally ſit on the ſhrubs that hang over the water; and, when they ſhoot out their long ſlender necks, are often taken for ſerpents at firſt ſight.

Mr Latham deſcribes three varieties of this ſpecies, which are all equal in ſize to the common birds of the ſpecies. The firſt and the ſecond variety, which laſt Mr Latham calls the black darter, inhabit Cayenne; and third, or rufous darter, inhabits Africa, particularly Senegal, where it is called *kandar*.

3. The Surinam darter is about 13 inches long, being about the ſize of a teal. The bill is of a pale colour, and about 1$\frac{1}{8}$ inch in length: the irides are red: the crown of the head is black, and the feathers behind form a ſort of creſt: the neck, as in the other ſpecies, is long and ſlender: the cheeks are of a bright bay colour: from the corner of each eye there comes a line of white: the ſides and back part of the neck are marked with longitudinal lines of black and white: the wings are black, and the tail is duſky brown: it is alſo tipped with white and ſhaped like a wedge: the breaſt and belly are white: the legs ſhort, but very ſtrong, and of a pale duſky colour: the four toes are joined by a membrane, and barred with black. This ſpecies inhabits Surinam, frequenting the ſides of rivers and creeks, where it feeds on ſmall fiſh and inſects, eſpecially on flies, which it catches with great dexterity. When domeſticated, which often happens, the inhabitants call it the *ſun bird*. Authors have differed exceedingly concerning the genus to which this ſpecies belongs, ſince it is found to differ from the others in ſome pretty eſſential characters: it agrees, however, in ſo many, and thoſe the moſt eſſential, as ſufficiently to excuſe thoſe naturaliſts who claſs it with the plotus genus. See *Latham's Synopſis of Birds*, vol. iii. part 2. p. 627.

1
The plough

PLOUGH, in agriculture: A machine for turning up the ſoil by the action of cattle, contrived to ſave the time, labour, and expence, which, without this inſtrument, muſt have been employed in digging the ground, and fitting it for receiving all ſorts of ſeed. See AGRICULTURE, n° 83—95.

Amidſt all the varieties which can occur in the manner of ploughing the ground, ariſing from difference of ſoil, local habits, and other cauſes, there is ſtill a ſameneſs in the taſk which gives a certain uniformity to the chief parts of the inſtrument, and ſhould therefore furniſh principles for its conſtruction. There is not, perhaps, any invention of man that more highly merits our utmoſt endeavours to bring it to perfection; but it has been too much neglected by thoſe perſons who ſtudy machines, and has been conſidered as a rude tool, unworthy of their attention. Any thing appears to them ſufficient for the clumſy taſk of turning up the ground; and they cannot imagine that there can be any nicety in a buſineſs which is ſucceſsfully performed by the ignorant peaſant. Others acknowledge the value of the machine, and the difficulty of the ſubject; but they think that difficulty inſuperable, becauſe the operation is ſo complicated, and the reſiſtances to be overcome ſo uncertain, or ſo little underſtood, that we cannot diſcover any unequivocal principle, and muſt look for improvement only from experience or chance.

2
An inſtrument of the greateſt value,

But theſe opinions are ill founded. The difficulty is indeed great, and it is neither from the ignorant farmer nor the rude artiſt that we can expect improvement. It requires the ſerious conſideration of the moſt accompliſhed mechanic; but from him we *may* expect improvement. We have many data: we know pretty diſtinctly what preparation will fit the ground for being the proper receptacle for the ſeed, and for ſupporting and nouriſhing the plants; and though it is, perhaps, impoſſible to bring it into this ſtate by the operation of any inſtrument of the plough kind, we know that ſome ploughs prodigiouſly excel others in reducing the ſtiff ground to that uniform crumbling ſtate in which it can be left by the ſpade. The imperfections of their performance, or what yet remains to be done to bring the ground into this ſtate, is diſtinctly underſtood. It ſeems, then, a determinate problem (to uſe the language of mathematicians), becauſe the operation depends on the invariable laws of mechanical nature.

3
And may be improved.

4
The taſk it performs.

It will therefore be very proper, under this article, to aſcertain, if poſſible, what a plough in general ought to be, by deſcribing diſtinctly its taſk. This will ſure ly point out a general form, the chief features of which muſt be found under every variety that can ariſe from particular circumſtances.

The plough performs its taſk, not by digging, but by being pulled along. We do not aim at immediately reducing the ground to that friable and uniform ſtate into which we can bring it by the ſpade; but we wiſh to bring it into ſuch a ſtate that the ordinary operations of the ſeaſon will complete the taſk.

For this purpoſe, a ſlice or ſod muſt be cut off from the firm land. This muſt be ſhoved to one ſide, that the plough and the ploughman may proceed in their labour; and the ſod muſt be turned over, ſo that the graſs and ſtubble may be buried and rot, and that freſh ſoil may be brought to the ſurface; and all muſt be left in ſuch a looſe and open condition, that it may quickly crumble down by the influence of the weather, without baking into lumps, or retaining water. The firſt office is performed by the coulter, which makes a perpendicular cut in the ground. The point of the ſock follows this, and its edge gets under the ſod, and lifts it up. While lifting it up, it alſo heels it over, away from the firm land. The mould-board comes laſt, and puſhes it aſide, and gradually turns it over as far as is required.

Plate cccxcviii.
5
General form of the plough.

The general form of the body of a plough is that of a wedge or very blunt chiſſel, AFEDBC, (fig. 1.), having the lower corner D of its edge conſiderably more advanced than the upper corner B; the edge BD and the whole back AFDB is in the ſame perpendicular plane; the bottom FDB approaches to a triangular form, acute at D, and ſquare at F; the ſurface BCED is of a complicated ſhape, generally hollow, becauſe the angle ABC is always greater than FDE: this conſequence will be eaſily ſeen by the mathematician. The back is uſually called the LAND SIDE by the ploughmen, and the baſe FDE is called the SOLE, and FE the HEEL, and BCED the mould-board. Laſtly, the angle AFE is generally ſquare, or a right angle, ſo that the ſole has level both as to length and breadth.

6
Advantages of this form.

By comparing this form with attention, the reader will perceive, that if this wedge is pulled or puſhed along in the direction FD, keeping the edge BD always in the perpendicular cut which has been previouſly made by the coulter, the point D will both raiſe the earth and ſhove it to one ſide and twiſt it over; and, when the point has advanced from F to D, the ſod, which formerly reſted on the triangle DFE, will be forced up along the ſurface BCED, the line DF riſing into the poſition D*f*, and the line EF into the poſition E*f*.—Had the bottom of this furrow been covered with a bit of cloth, this cloth would be lying on the mould-board, in the poſition D*f*E: the ſlice thus deranged from its former ſituation, will have a ſhape ſomething like that repreſented in fig. 2.

In as much as the wedge raiſes the earth, the earth preſſes down the wedge; and as the wedge puſhes the earth to the right hand, the earth preſſes the wedge to the left; and in this manner the plough is ſtrongly preſſed, both to the bottom of the furrow by its ſole, and alſo to the firm land by its back or land-ſide. In ſhort, it is ſtrongly ſqueezed into the angle formed along the line FD (fig. 1.) by the perpendicular plane *a b* DF and the horizontal plane FDE; and in this manner the furrow becomes a firm groove, directing the motion of the plough, and giving it a reſiſting ſupport, by which it can perform all parts of its taſk. We beg our readers to keep this circumſtance conſtantly in mind. It evidently ſuggeſts a fundamental maxim in the conſtruction, namely, to make the land-ſide of the plough an exact plane, and to make the ſole, if not plane, at leaſt ſtraight from point to heel. Any projection would tear up the ſupporting planes, deſtroy the directing groove, and expend force in doing miſchief.

7
A fundamental maxim in the conſtruction of a plough.

This wedge is ſeldom made of one piece. To give it the neceſſary width for removing the earth would require a huge block of timber. It is therefore uſually framed of ſeveral pieces, which we ſhall only mention in order to have the language of the art. Fig. 3. repreſents the land-ſide of a plough, ſuch as are made by James Small at Roſebank, near Foord, Mid Lothian, Scotland. The baſe of it CM, is a piece of hard wood, pointed before at C to receive a hollow ſhoeing of iron CO, called the SOCK, and tapering a little towards the hinder end, M, called the HEEL. This piece is called the Head of the plough. Into its fore part, juſt behind the ſock, is mortiſed a ſloping poſt, AL, called the SHEATH, the front of which is worked ſharp, forming the edge of the wedge. Nearer the heel there is mortiſed another piece, PQ, ſloping far back, called the STILT, ſerving for a handle to the ploughman. The upper end of the ſheath is mortiſed into the long BEAM RH, which projects forward, almoſt horizontally, and is mortiſed behind into the ſtilt. To the fore end of the beam are the cattle attached. The whole of this ſide of the wedge is faſhioned into one plain ſurface, and the intervals between the pieces are filled up with boards, and commonly covered with iron plates. The COULTER, WFE, is firmly fixed by its ſhank, W, into the beam, rakes forward at an angle of 45° with the horizon, and has its point E about ſix inches before the point of the ſock. It is brought into the ſame vertical plane with the land-ſide of the plough, by giving it a knee outward immediately below the beam, and then kneeing it again downward. It is further ſupported on this ſide by an iron ſtay FH, which turns on a pin at F, paſſes through an eye-bolt I on the ſide of the beam, and has a nut ſcrewed on it immediately above. When ſcrewed to its proper ſlope it is firmly wedged behind and before the ſhank.—Fig. 3. N°. 2. repreſents the ſame plough viewed from above. ST is the right hand or ſmall ſtilt fixed to the inſide of the mould-board LV.

8
The ſeveral parts of the plough.

Fig. 4. repreſents the bottom of the wedge. CM is the head, covered at the point by the ſock. Juſt behind the ſock there is mortiſed into the ſide of the head a ſmaller piece DE, called the wreſt, making an angle of 16° with the land-ſide of the head, and its outſide edge is in the ſame ſtraight line with the ſide of the ſock. From the point to the heel of the head is about 33 inches, and the extreme breadth of the heel is about nine. The ſide of the wedge, called the furrow ſide, is formed by the mould-board, which is either made of a block or plank of wood, or of a thick iron plate.

9
Socks.

The ſock drawn in this figure is called a SPEAR SOCK, and is chiefly uſed in coarſe or ſtony ground, which requires great force to break it up. Another form of the ſock is repreſented in the next figure 4. N° 2. This is called a FEATHER SOCK, and has a cutting edge CF on its furrow ſide, extending back about ten inches, and to the right hand or furrow ſide about ſix. The uſe of this is to cut the ſod below, and detach it from the ground, as the coulter detaches it from the unploughed land. This is of great uſe when the ground is bound together by knotted roots, but it is evident that it cannot be uſed to advantage in very ſtony ground. In general the feather ſock is only fit for ground which has been under tolerable culture; but it greatly facilitates the labour of ſeparating the ſod. It may reaſonably be aſked, why the feather is not much broader, ſo as to cut the whole breadth of the furrow? This is ſometimes done. But we muſt recollect that the ſod is not only to be puſhed aſide, but alſo to be turned over. If it were completely detached by the feather, and chanced at any time to break on the back of the ſock, it would only be puſhed aſide; but by leaving a little of the ſod uncut, it is held faſt below while it is ſhoved aſide above, which cannot fail to twiſt it round. As the wreſt advances, it eaſily deſtroys the remaining connection, which in general is very ſlight and crumbling.

10
Proper breadth of the ſole,

The breadth of the ſole at the heel determines the width of the furrow. Nine inches will give enough of room for a horſe or man to walk in. A greater breadth is of no uſe, and it expends force in puſhing the earth aſide. It is a miſtake to ſuppoſe that a broad ſole gives more room for the turned ſlice to ſtand on; for whatever is the breadth of the furrow, the ſucceſſive ſlices will be left at their former diſtances, becauſe each is ſhoved aſide to the ſame diſtance. When the breadth of a ſlice exceeds its depth, and it is turned on its ſide, it will now ſtand on a narrow baſe, but higher than before, and therefore will ſtand looſer, which the farmers deſire. But in this caſe it generally falls on its back before it has been far enough removed, and is then puſhed aſide, and left with the graſſy ſide down, which is not approved of. On the other hand, when the depth conſiderably exceeds the breadth, the ſods, now turned on their ſides, muſt be ſqueezed home to the ploughed land, which breaks them and toſſes them up, making rough work. In wet clay ſoil, this is alſo apt to knead them together. On the whole, it is beſt to have the breadth and depth nearly equal. But all this is workmanſhip, and has no dependance on the width of the ſole behind.

11
It ſhould be level.

We have already ſaid that the ſole is generally level from right to left at the heel. This was not the caſe formerly, but the wreſt was conſiderably raiſed behind. It reſulted from this form, that the furrow was always ſhallower on the right ſide, or there was left a low ridge of unſtirred earth between the furrows. This circumſtance alone was a bad practice; for one great aim of ploughing is the renewal of a ſuperficial ſoil. In this way of ribbing the furrows, the ſod tumbles over as ſoon as it is puſhed to the top of the rib on the right of the *rut* made by the plough; the firmeſt parts of it fall undermoſt, and the reſt crumbles above it, making the work appear neat; whereas it is extremely unequal, and what moſt needs the influence of the weather to crumble it down is ſheltered from it. Add to theſe circumſtances, that the hollow is a receptacle for water, with a ſurface which can retain it, having been conſolidated by the preſſure of the plough. For all thoſe reaſons, therefore, it ſeems adviſable to form the furrow with a flat or level bottom, and therefore to keep the heel of the wreſt as low as the heel of the head. For the ſame reaſon it is proper to hold the plough with the landſide perpendicular, and not to heel it over that ſide, as is frequently done, producing the ſame ribbed furrow as an ill-formed ſole.

12
Length of the plough.

There is great variety of opinions about the length of the plough. If conſidered merely as a pointed inſtrument, or even as a cutting inſtrument acting obliquely on a given length of ſod, there can be no doubt but that it will be more powerful as it is longer: that is, it will require leſs force to pull it through the ground. But it muſt alſo ſhove the earth aſide, and if we double its length we cauſe it to act on twice as much earth at once; for when the plough has entered as far as the heel, the whole furrow ſide is acting together in puſhing the earth to the ſide. Now it is found that the force neceſſary for puſhing a maſs of earth horizontally along the rough ground is nearly equal to its weight. It would ſeem, therefore, that nothing is to be gained by making the baſe of the plough of a great length, except a greater facility in making the firſt penetration, and this is chiefly performed by the coulter and ſock; and a great length renders the plough heavy and cumberſome; and by cauſing it to act long on the ſod, tends to knead and cake it.

13
Slope of the coulter and of the feather.

Nothing very preciſe can be offered on this ſubject. Some ſenſible advantage is derived by making the plough taper, eſpecially forward, where it acts as a boring and cutting inſtrument; and for this purpoſe it is convenient to give the coulter a ſlope of 45 degrees. (This has alſo the advantage of throwing up the ſtones and roots, which it would otherwiſe drive before it through the firm ground.) And for the ſame reaſon the edge of the feather has a great ſlope, it being ten inches long and only ſix inches broad. But if we purſue this advantage too far we expoſe ourſelves to another riſk. It is ſometimes neceſſary to heel over the plough to the right in order to get over ſome obſtruction. In doing this, the coulter is neceſſarily raiſed for a moment, and the ſlanting cut now made by the feather becomes the directing groove for the plough. When the feather has a very long ſlope, this groove has force enough to guide the whole plough; and it is almoſt impoſſible for the ploughman to prevent it from running out of the ground to the land-ſide (A). The feather, therefore, ſhould not exceed 10 or 12 inches in length.

But to return to the length of the plough, from which this obſervation has diverted us a little, we muſt add that a long plough has a great advantage in the ſteadineſs of its motion, having a much more extenſive ſupport both on the land-ſide and below, and being therefore leſs affected by its inequalities. Accordingly they are now made conſiderably longer than formerly; and 33 inches has been aſſumed as a proportion to 9 inches of breadth, in conformity to the moſt approved ploughs now in uſe.

14
The mould-board.

We come now to treat of the mould-board. This is

(A) This is often felt with the excellent plough deſcribed by Mr Arbuthnot of Surry in the Tranſactions of the Society for the Encouragement of Arts, &c. London.

is the moſt delicate part of the plough, and is to be ſeen in the greateſt variety in the works of different artiſts, each of whom has a noſtrum of great value in his own opinion. It is here indeed that the chief reſiſtances are exerted and muſt be overcome; and a judicious form of this part of the plough may diminiſh them conſiderably, while it performs the work in the beſt manner. Without pretending to ſay that the different reſiſtances are ſuſceptible of an accurate determination, we can ſtill draw ſufficient information from palpable rules of mechanics to direct us to what would be nearly the beſt poſſible form for a mould-board. The taſk to be performed is to raiſe, puſh aſide, and turn over to a certain degree, a ſlice already cut off from the firm ground. As we cannot provide for every inequality of the coheſion or tenacity of the earth, our ſafeſt way is to conſider it as uniform: the weight of it is always ſo. As we cannot provide for every *proportion* between the tenacity and the weight, we muſt take an average or medium proportion which is not far from that of equality. Conceiving the ſlice at firſt as only tenacious, and without weight, it is an eaſy problem to determine the form which ſhall give it the intended twiſt and removal with the ſmalleſt force. In like manner we can proceed with a ſlice that has weight without tenacity. It is equally eaſy to combine both in any proportion; and it is eaſieſt of all to make this combination on the ſuppoſition of equality of weight and coheſion. Suppoſing the ſlice like a brick, we know that it requires the greateſt force to *begin* to raiſe it on one edge, and that the ſtrain becomes leſs as it riſes, till its centre of gravity is perpendicularly above the ſupporting angle. It requires no force to raiſe it further; for on puſhing it beyond this poſition, it would fall over of itſelf, unleſs withheld by the tenacity of what is not yet raiſed. But on conſidering the form or plan of the ſock, we find that while the weight of the ſod reſiſts moſt ſtrongly, there is leſs of it in this ſituation actually riſing, and this nearly in the ſame proportion with the labour of raiſing it; and we ſee that after the ſod has attained that poſition in which it is ready to fall over, it has reached the wider part of the wreſt, and is now puſhed aſide, which requires nearly the ſame force as to raiſe it: and this continues to the end of the operation.

When we take all theſe circumſtances into conſideration, it appears probable, that the compound reſiſtance does not change much from firſt to laſt. If this be really the caſe, it is an undoubted maxim that the whole operation ſhould proceed equably: if it does not, there muſt be ſome part of the ſod that makes a reſiſtance greater than the medium; and as the reſiſtances in all this claſs of motions increaſe nearly as the ſquares of the velocities with which they are overcome, it is demonſtrable that we ſhall loſe power if we render them unequal.

15
How to be performed.

Hence we deduce this maxim, *That as the plough advances through equal ſpaces, the twiſt and the lateral ſliding of the ſod ſhould increaſe by equal degrees.* And this determines *à priori* the form of the mould-board. This principle occurred to Mr James Small a ploughmaker in Berwickſhire, and he publiſhed a treatiſe on the ſubject in 1784. He has given ſeveral methods for conſtructing mould-boards, which he ſuppoſes are in conformity to his principle; but being merely a country artiſt, and unacquainted with ſcience, his rules do not produce mould-boards having this property of equable operation, altho' they do not deviate far from it. His book is a very uſeful and inſtructive performance, and level to the capacity of thoſe for whom it is intended; and we have here availed ourſelves of the author's information on many points.

The high character which Small's ploughs have maintained for 25 years is a ſtrong argument for the truth of the maxim. We ſhall therefore give ſuch inſtructions as will enable any intelligent workman to conſtruct ſuch a mould-board without any riſk of failure; and if future theory or experience ſhould diſcover any error in the principles from which this maxim is deduced, by ſhowing that either the weight, the tenacity, or the lateral reſiſtance, is exerted according to a different law from what has been aſſumed, the directions to be given are of ſuch a nature that they adapt themſelves with preciſion to theſe changes of principle, and will ſtill produce a perfect and efficacious plough. Our readers will readily acknowledge that this is gaining a great point; becauſe at preſent the inſtrument is conſtructed very much at random, and by a gueſs of the eye.

Let us now return to the wedge formerly made uſe of for illuſtrating the action of the plough. Suppoſe it placed in a furrow already ploughed, and that the ſpace before the line FE (fig. 1.), which is ſquare from the line of motion FD, is covered with a piece of cloth or carpet, and that the point of the wedge enters upon it at F, and advances to D. It will evidently raiſe the cloth, which will now cover the ſide of the wedge, forming the triangle *f* DE. The line *f* D is what formerly lay in the angle along the line FD, and *f* E formerly lay on FE. It is this line FE therefore that we are to raiſe, ſhove aſide, and twiſt round, by equal degrees, while the plough advances through equal ſpaces.

Now, if the length DF of the plough-wedge, reckoned from the point of the ſock to the heel, be 33 inches, and the breadth FE behind be 9 inches, the angle DEF or DE*f* will be nearly 74°. The conſtruction of the furrow ſide of the plough is therefore reduced to this very ſimple problem, "To make the angle DE*f* turn equably round the axis DE, while the angular point E advances equably from D to E."

16
Deſcription of an inſtrument for this purpoſe.

This will be done by means of the following very ſimple tool or inſtrument. Let IHFK (fig. 5.) be a piece of hard wood, ſuch as oak, a foot long, three inches broad, and an inch thick. Plant on this another piece BHFC of the ſame breadth, four inches long, and half an inch thick. This will leave beyond it a flat 8 inches long. We ſhall call this the *ſtock* of the inſtrument. Let ABC be a piece of clean oak half an inch thick, 20 inches long, and three inches broad at the end BC. Let this be faſhioned like the ſtile of a ſun-dial, having its angle ABC 74°. Let it have a part BCE ſquare, to the extent of four inches from C, and the reſt EA worked into the form of a ſtraight ſlender rod. Let EFG be a ſemicircle of clean plane-tree or of metal four inches radius: faſten this by ſmall ſcrews to the ſquare part of the ſtile CE, ſo that its centre may be at C. Let this ſemicircle be divided into 180 degrees, and numbered from G along the arch GFE, ſo that 0° may be at G, and 180° at E. Let this ſtile and ſemicircle turn round the line BC by means of ſmall hinges. This inſtrument may be called the mould-board, gage, or protractor. When the ſtile is folded down on the ſtock BIK, the point G will be at F; and when it is raiſed up to any angle, the degrees will be pointed out on the ſemicircle by the ſtraight edge CF.

Nothing can be more obvious than the manner of employing this inſtrument if once we have determined the moſt proper poſition for the ſod when the work is completed. Now it ſeems to be the opinion of the moſt intelligent farmers, that the beſt poſition of the ſod is that repreſented in fig. 6.

17
Proper poſition of the ſod.

Fig. 6. repreſents a ſection of the ground and the working parts of the plough, as viewed by a perſon ſtanding ſtraight before it. ABDC is the unploughed ground, and WB the coulter, kneed in Small's manner. FGKB is the ſection of the plough (or rather of the whole ſpace through which the plough has paſſed, for no part of the plough has this ſection). HOFE is the ſection of a ſlice, puſhed aſide and turned over, ſo as to lean on the next. HE is that ſide of the ſlice which formerly lay on KB. EF is the ſide cut off by the coulter; and FO is the upper or graſſy ſide. The lower corners are ſuppoſed to be a little bruiſed inwards, as muſt generally happen.

The ſod is puſhed 9 inches to the right hand, and it leans with its graſſy ſide on the preceding furrow, in an angle of about 50 degrees. In this poſition the graſs is turned down ſo as to rot; and there is a hollow left below to allow the rain water to run freely off, and to receive the earth as it crumbles down by the weather: and if the harrow is dragged acroſs theſe ridges, it diſtributes along the ſurface the mould which was formerly at the bottom. The ſod has got a twiſt of 130 degrees: but it is evident, that after it has been turned 90 degrees, or even a little before this, it is ready to fall over of itſelf. It is ſufficient therefore that it be turned 90 degrees when the heel of the wreſt has reached it, and the remainder of the twiſt is given to it by the wing or flap of the mould-board. This, then, dictates to us the manner of applying the inſtrument.

18
How to form the mould-board.

Divide the edge DE (fig. 7.) of the wreſt, or of a lath nailed on it, into 90 equal parts, and continue the diviſions backwards to G in the ſame line to 130. Number the diviſions backwards from the point of the ſock; then place the protractor on the edge of the wreſt, with the point B of fig. 5. at the 90th diviſion (fig. 7.); that is, juſt at the heel, with the ſtock under the wreſt, and the ſtile raiſed to 90°, and preſs it home to the joint, ſo that the ſtock may be ſquare to the edge, and then the ſtile will be in the poſition ſuiting that part of the mould-board. In like manner ſlide the ſtock forward to the 80th diviſion, and lower the ſtyle to 80°, and it will have the poſition which ſuits that part of the mould-board. In the ſame way ſlide it forward to 70, 60, 50, &c. and lower the ſtile to 70°, 60°, 50°, &c. and we ſhall have the poſition for theſe ſeveral parts of the mould-board; and thus it may be formed to the very point-of-the-ſock, becauſe the ſtraight edge of the wreſt may be continued ſo far. A block of wood may be hewed to fit theſe ſeveral poſitions of the protractor ſtile; and this, when placed with its ſtraight edge on the outer line of the wreſt, and cut away behind in the land-ſide plane, will be the exact ſhape of the plough-wedge. It would riſe up indeed into a tall piece of ſingular ſhape, gradually tapering down to the point of the ſock; but when cut off parallel to the grouud, at the height of about 12 inches, it will form the mould-board, the front or edge of the ſheath, and the whole back of the ſock except the feather, which is an extraneous piece. The wing or flap of the mould-board is formed in the ſame manner, by ſliding the ſtock of the protractor to 100, 110, 120, 130, and opening the ſtile to 100°, 110°, 120°, 130°. This will extend the top of the mould-board to about 22 or 23 inches; but the lower part of the wing muſt be cut away, becauſe it would puſh the ſod too far aſide after it has got the proper twiſt. The form of this part ſhould be ſuch as would exactly apply itſelf to a plank ſet at the heel of the wreſt, parallel to the land-ſide of the head, and leaning outward 40 degrees. This will be very nearly the caſe if it be made a ſweep ſimilar to the edge of the ſheath. Fig. 8. is a reſemblance of the ſurface of the mould-board; AD being the edge of the ſheath, E the heel of the wreſt, and EBC the wing or flap. When cut through in a perpendicular direction the ſection is hollow; if cut horizontally it is convex; and if in the directions CE, making an angle of 74° with ED, it is ſtraight. If the protractor be ſet on it at D, and gradually ſlidden backwards, the mould-board will gradually open the ſtile, and the ſtile will ſkim its whole ſurface without vacuity between them.

This form is given to the mould-board on the authority of the ſuppoſition that the ſum of the reſiſtances ariſing from weight and tenacity remains pretty conſtant in its whole length. This cannot be affirmed with confidence in any caſe, and is by no means true in all. In ſtiff clay ſoils the effects of tenacity prevail, and in light or crumbling ſoils the weight is the chief reſiſtance. The advantage of this mode of conſtruction is, that it can be adapted to any ſoil. If the difficulty of cutting and raiſing the ſod is much greater than that of ſhoving it aſide and turning it over, we have only to make the riſe and twiſt more gentle towards the point of the ſock, and more rapid as we advance; and it is eaſy to do this according to any law of acceleration that we pleaſe. Thus, inſtead of dividing the edge of the wreſt DE (fig. 9.) continued to G into 130 parts, draw a line G *g* perpendicular to it, and draw ſome curve line D *g* convex toward DG, and divide this into equal parts in the points 10, 20, 30, 40. &c.; and then draw perpendiculars to the wreſt edge, cutting it in 10, 20, 30, 40, &c. and apply the protractor to theſe points. It is evident that the diviſions of the wreſt line are bigger at D, and grow gradually leſs towards G; and therefore, becauſe each has 10° more twiſt than the preceding, the twiſt will be more rapid as it approaches the end of the mould-board. This curve may be choſen ſo as to produce any law of acceleration. On the contrary, we produce a retarded or diminiſhed twiſt by making the curve concave towards DG, as repreſented by the dotted curve.

The mathematical reader will obſerve, that this conſtruction aims at regulating the twiſt round the line of the wreſt ED. This does not produce preciſely the ſame regulation round the line FD, which is the line of the plough's motion, and of the ſod's poſition before it is ploughed over. The difference, however, is not worth attending to in a matter ſo little ſuſceptible of preciſion. But the twiſt round the line FD may be regulated according to any law by this inſtrument with equal facility. Inſtead of placing the ſtock of the protractor ſquare with the edge of the wreſt, it may be placed ſquare with the land-ſide of the plough. To do this, draw a line BL (fig. 5. n° 2.) acroſs the ſtock from the point B, making the angle LBC 16°, and put a braſs pin at L, making a hole in the ſtyle that it may not be prevented from folding down. Then in uſing the inſtrument let the points B and and L reſt againſt the edge of the wreſt, and proceed as directed.

A ſtill greater variety of forms, and accommodation to particular views, with the ſame general dependence on principle, will be procured by giving the rod BA a motion round B in the plane of the ſtile, ſo as to form, a ſtile of a variable angle.

A tool may even be conſtructed in which the rod BA might be a cutting knife; and the whole may be led along by a ſcrew, while this knife turns round according to any law, and would gradually pare away the mould-board to the proper form.

Thus have we reduced the faſhioning the operative part of the plough to a rule which is certain. We do not mean by this, that a mould-board made according to the maxim now given will make the beſt poſſible plough; but we have given a rule by which this part of the plough can be made unequivocally of a certain quality by every workman, whatever this quality may be, and this without being obliged to copy. No deſcription of any curve mould-board to be met with in books has this advantage; and we ſay that this rule is capable of any ſyſtematic variation, either with reſpect to the width of furrow, or the quantity or variation of its twiſt. We have therefore put it in the power of any intelligent perſon to make ſuch gradual and progreſſive changes as may ſerve to bring this moſt uſeful of all inſtruments to perfection. The angle of the head and wreſt, and the curve for dividing the wreſt line, can always be expreſſed in writing, and the improvements communicated to the public at large.

19 Mode of the plough's action.

After this deſcription of the working parts of a plough, and directions for giving it the moſt effective form, it will not be improper to conſider a little its mode of action, with the view of attaining a more diſtinct conception of what is done by the ploughman and the cattle, and to direct him in his procedure.

Returning again to the wedge (fig. 1.), we ſee that it is preſſed down at the point D, and as far back along the mould-board as its ſurface continues to look upward, that is, all the way to the heel of the wreſt. Behind this, the perpendicular ſections of the mould-board overhang, and look downward; and here, while preſſing down the ſod, the plough is preſſed upwards. Theſe two preſſures tend to twiſt the plough round a tranſverſe line ſomewhere between the heel and the point. The plough therefore tends to riſe at the heel, and to run its point deeper into the ground. Upon the whole, the preſſure downwards is much greater than the upward preſſure. It is exerted over a much greater ſpace, and is greater in moſt parts of that ſpace. Behind, very little downward preſſure is neceſſary, the ſod being ready to fall down of itſelf, and only requiring a gentle touch to lay it in a proper poſition.

In like manner the plough is preſſed backward by the reſiſtance made to the coulter and ſock, and part of the reſiſtance made to the ſloping ſide of the mould-board: and it is preſſed to the left by the other part of the preſſure on the ſock and mould-board.

All theſe preſſures muſt be balanced by the joint action of the cattle the reſiſtance of the bottom, and the reſiſtance of the firm ground on the left hand or land-ſide.

It is the action of the cattle, exerted on that point to which they are attached, which produces all theſe preſſures. It is demonſtrated by the principles of mechanics, that this force muſt not only be equal to the mean or compound force of theſe reſiſting preſſures, but muſt alſo be in the oppoſite direction.

It is further demonſtrated, that if a body be dragged through any reſiſting ſubſtance by a force acting on any point G, and in any direction whatever GH, and really moves uniformly in that direction, the force exerted exactly balances the reſiſtances which it excites, both as to quantity and direction: And if the body advances without turning round the point by which it is dragged the reſiſtances on one ſide of this point are in equilibrio with thoſe on the oppoſite ſide.

And, laſtly, it is demonſtrated, that when this equilibrium is obtained, it is indifferent to what point in the line GH the force is applied. Therefore, in fig. 3, n° 1, the force acting in the direction HO may either be applied to the point of the beam H, or to the point N of the coulter, or to the point O of the ſock.

When therefore a plough advances ſteadily, requiring no effort of the ploughman to direct it, if the line of draught OM (fig. 10.) be produced backwards to the point G of the mould-board, that point is the place round which all the reſiſtances balance each other. This point may be called the *centre of reſiſtance* and the *centre of action*.

It would be of importance to determine this point by principle; but this can hardly be done with preciſion even in a plough of a known form: and it is impoſſible to do it in general for all ploughs, becauſe it is different in each. It even varies in any plough by every variation of the proportion between the weight and the coheſion of the ſod. We ſee how it can be found experimentally in any given uniform ſod, viz. by producing backwards the line of draught. Then, if the draught-rope, inſtead of being fixed to the muzzle of the beam, were fixed to this point, and if it were pulled in the ſame direction, the plough would continue to perform its work without any aſſiſtance from the ploughman, while the ſod continued uniform. But the ſmalleſt inequality of ſod would derange the plough ſo as to make it go entirely out of its path. Should the reſiſtances between G and D prevail, the plough would go deeper, which would increaſe the reſiſtances on that ſide where they already exceed, and the plough would run ſtill deeper. Should the reſiſtances behind G prevail, the heel would be preſſed down, and the point would riſe, which would ſtill farther deſtroy the equilibrium, and, producing a greater deviation from the right path, would quickly throw the plough out of the ground.

For theſe reaſons we muſt not think of attaching the draught to the centre of reſiſtance; but muſt contrive a point of draught ſuch as ſhall reſtore the plough to its proper poſition when it has been driven out of it by any obſtruction.

20 Muzzle of the beam.

The muzzle or end of the beam is a point which will completely ſuit our purpoſe. For ſuppoſe that the reſiſtance

PLOUGH. Plate CCCXCVIII.

Fig. 1.

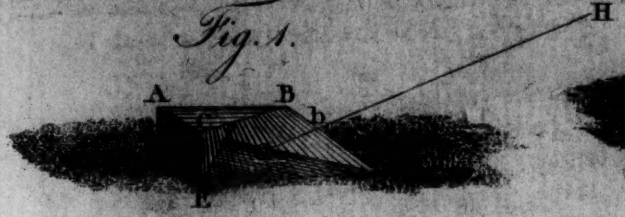


Fig. 2.

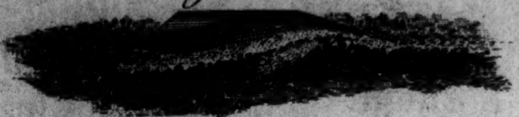


Fig. 4. No. 1.

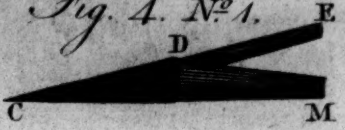


Fig. 4. No. 2.

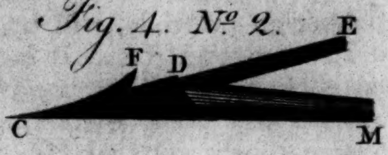


Fig. 3. No. 1.

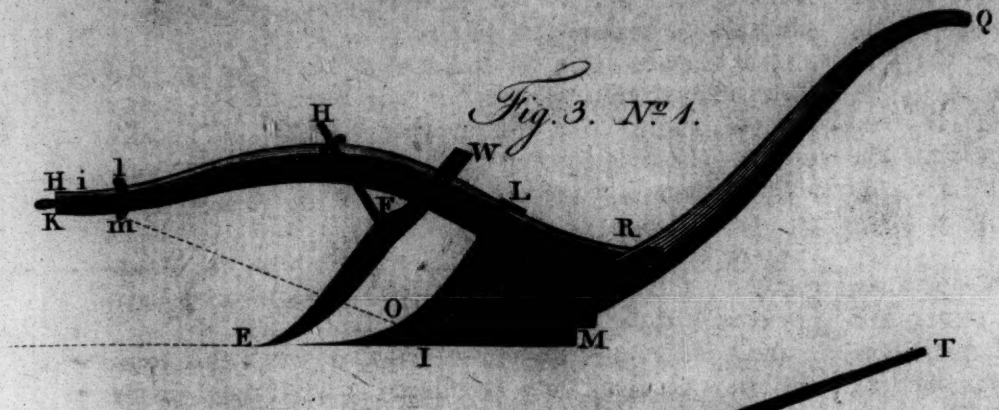

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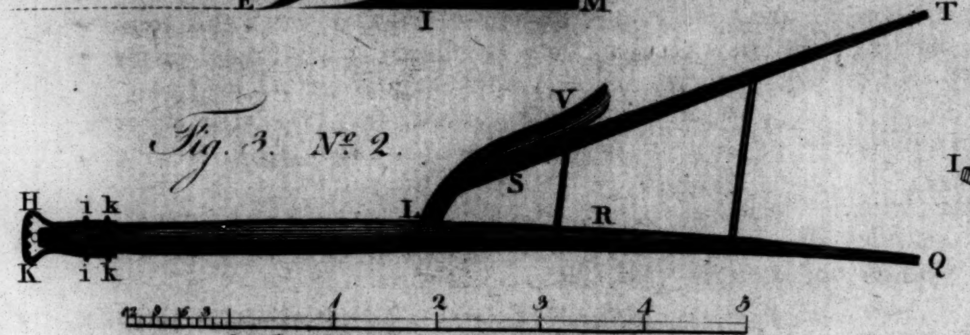
Fig. 3. No. 2.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Scale of Feet for Small's Plough.

Fig. 5. No. 1.

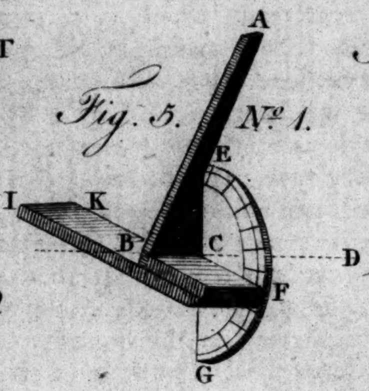

Fig. 5 No. 2.

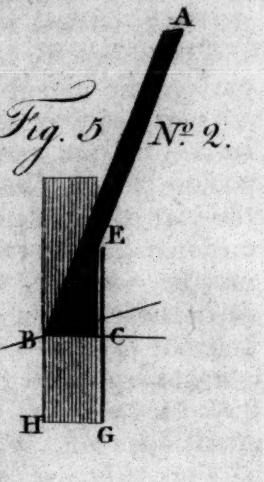

Fig. 6.

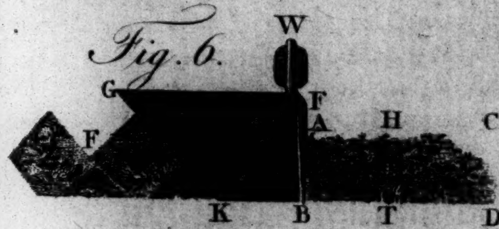
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Fig. 7.

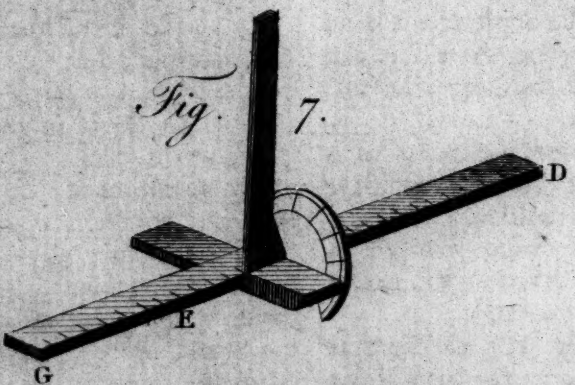


Fig. 8.

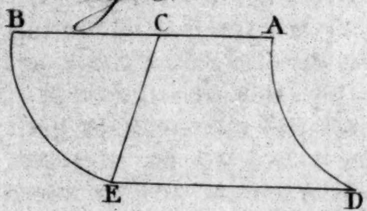
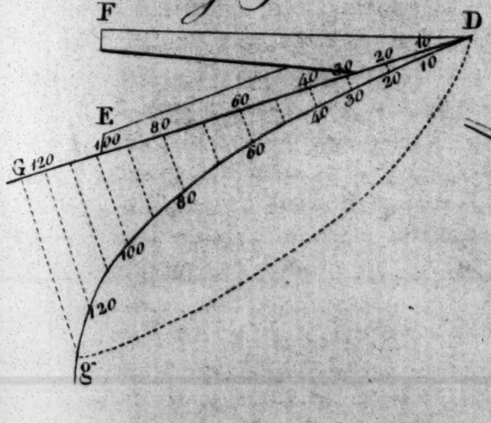


Fig. 9.


F
D
10
20
30
40
10
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30
40
E
60
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g

Fig. 11. The Argyleshire Plough.

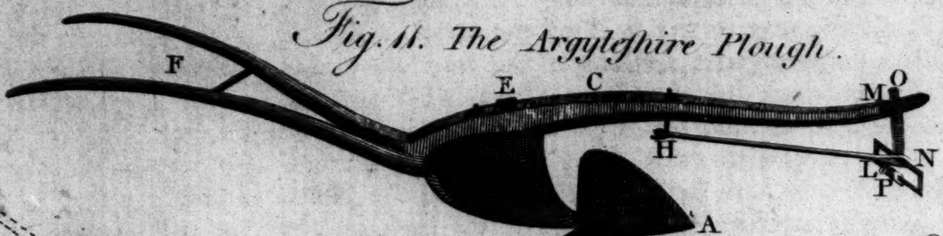
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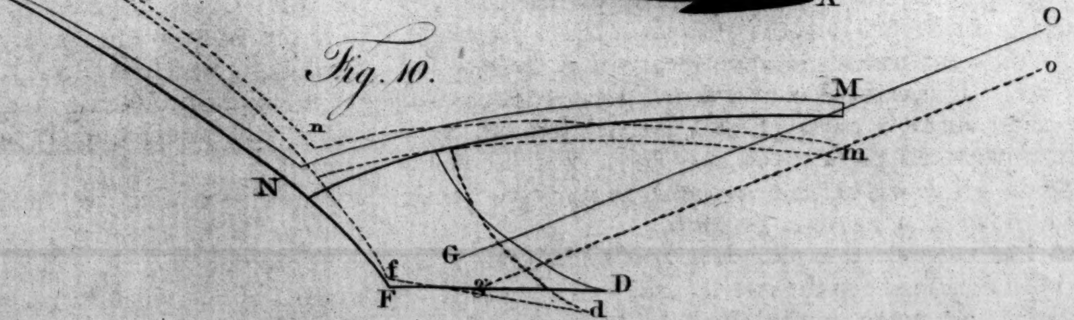
Fig. 10.


O
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n
m
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G
f
F
g
D
d

Thackara sc.

BRITISH MUSEUM

ſiſtance on the back of the ſock has prevailed, and the plough MNFD (fig. 10.) has taken the poſition *mnfd* repreſented by the dotted lines, the draught line GMO is brought down into the poſition *gmo*, diverging a little from GMO, and meeting the mould-board in a point *g* conſiderably before G. By this means the reſiſtances on the hinder ſide of *g* are increaſed, and thoſe before it are diminiſhed, and the plough quickly regains its former poſition.

21 The point of draught. From theſe obſervations it is plain, that whatever is the ſituation of the centre of reſiſtance, the point of draught may be ſo choſen that the action of the cattle ſhall be directly oppoſed to the reſiſtance of the ground, and that moreover the plough ſhall have no tendency either to go deeper or to run out. This is the uſe of the apparatus at the point of the beam called the muzzle, repreſented at H (fig. 3.) It turns round a bolt *i* through the beam, and can be ſtopped at any height by another pin *k* put through the holes in the arch *lm*. A figure is given of the muzzle immediately below, as it appears when looking down on it. The eye to which the draught rope is hooked is ſpread out horizontally, as ſhown by HK, and has ſeveral notches O in it, to either of which the hook can be applied. This ſerves to counteract any occaſional tendency which the plough may have to the right or left.

22 Of the plough in trim. When the plough goes on ſteadily, without any effort of the ploughman, it is ſaid to be in trim, and to ſwim fair; the preſſure before and behind the centre of action being in equilibrio with each other. In order to learn whether a plough will be in this manner under management, hook the draught-rope as high as poſſible. In this ſtate the plough ſhould have a continual tendency to riſe at the heel, and even to run a little into the ground. Then hook the rope as low as poſſible. The plough ſhould now preſs hard on the furrow with the heel, and have ſome tendency to run out of the ground. If both theſe are obſerved, the plough is properly conſtructed in this reſpect; if not, it muſt be altered, either by changing the poſition of the ſock or that of the beam. Lowering the end of the beam will correct the tendency of the plough to go deeper; the raiſing the point of the ſock will alſo have the ſame effect. But it is of conſiderable importance not to take the point of the ſock out of the plane of the ſod, and it is much better to make the alteration by the beam. The ſlope of the coulter has a conſiderable effect, but it cannot be placed very far from the inclination of 45° without the riſk of choaking the plough by driving the roots and ſtones before it. It is of great conſequence to have the coulter ſit exactly in the direction of the plough's motion: if it is in any other direction, it will powerfully twiſt the plough into its own track. As it muſt be fixed in the middle of the beam's thickneſs to have ſtrength, it is removed a little from the plane of the land-ſide, and it was the uſual practice to point it to the left below to compenſate for this; but this by no means removes the diſpoſition to twiſt. And it expoſes to the riſk of catching a ſtone between its point and that of the ſock, which muſt now be driven forward through the firm ground at a great expence of labour to the cattle. Mr Small has very ingeniouſly remedied this by giving the coulter a ſhort knee to the left immediately below the beam, and thus pointing it downwards in the plumb of the land-ſide. See fig. 6.

It is not without its uſe to know the abſolute force neceſſary for tilling the ground. This has been frequently meaſured with a ſpring ſteel-yard. One of Small's ploughs, worked by two horſes, and employed in breaking up ſtiff land which had been ploughed before winter, and much conſolidated by the rains, required a force of 360 lbs. avoirdupois; and we may ſtate this as the ordinary rate of ſuch work; but moderately firm ſod, under good culture, requires at a medium 320 lbs.

As we wiſh to embrace every opportunity of rendering this work uſeful to the public, we ſhall conclude this article with an account of a plough which has juſt now been recommended to public notice by the Scots Highland Society as extremely proper for a hilly country. The inventor, the Rev. Alexander Campbell miniſter at Kilcalmonell in Argyleſhire, was honoured with the Society's gold medal, value L. 25.

23 The Argyleſhire plough. A, the ſock (fig. 11.); the land-ſide of which ſupplies the place of the coulter, and the ſole of it ſerves for a feather; it is 18 inches long, and is made of a plate of iron 12 inches broad when finiſhed, and ſomewhat under half an inch thick.--B, the head; to be made of iron in a triangular form, 4 inches broad by 2 inches at the thickeſt part. There are 5 inches of the head fixed in the ſock.--C, the beam, 4 inches thick by 5 inches deep, gradually tapered thinner; the length 6 feet.--E, the ſheath, muſt be of the ſame thickneſs with the beam above and the head below, and is five inches broad. An iron ſcrew-bolt connects the beam and head behind the ſheath.--F, the handles are ſo made that the ſlope of the mould-board, which is fixed to one of them, may be the longer and more gradual. They are 5 feet 8 inches long, and 2 feet 4 inches aſunder at the ends.—G, the mould-board, conſiſts of 7 rounded ſticks 2 inches in diameter; the covert of them is in the plane of the ſole, the reſt in ſucceſſion cloſe to each other above it. This makes the mould-board 14 inches broad. To prevent any earth from getting over the mould-board, a thin dale 4 or 5 inches broad is fixed above it. The mould-board, land-ſide, and ſole of the plough, are clad with iron.—The length is 20 inches: this added to 18 inches, the length of the ſock, makes the length from point to heel 3 feet 2 inches.—The muzzle or bridle OPH is alſo of a more convenient and better conſtruction than thoſe commonly in uſe. By means of the ſcrew-pins at L and M different degrees of land may be given to the plough; the iron rod LH being thereby moved ſidewiſe in the ſocket LN, and up and down by OP. The rod is 30 inches long, one broad, and half an inch thick. It is hooked into a ſcrew-bolt at H. Two inches of the rod project at N, in the form of an eye, before the muzzle, to receive the hook of the croſs-tree.

The advantages of this plough are ſaid to be: It is not ſo liable to be interrupted or turned out of its courſe by ſtones, roots, &c. as other ploughs are; nor does it dip ſo deep as to be liable to be broken by large ſtones or flags. The motion of the muzzle is alſo thought an improvement. Another advantage it has over other ploughs is, its not being ſo liable to be choaked up by ſtubble, &c. This we underſtand to be its chief excellency, and an object much deſired in the conſtruction of the plough. Upon the whole, we are informed that this plough is lighter, leſs expenſive, and leſs liable to go out of trim than the ordinary plough, and that with it two horſes can plough land which require four with any other plough.

24 Objections to its conſtruction.

Such are ſaid to be the advantages of this conſtruction; but we cannot help expreſſing our apprehenſion that the uniting the coulter and feather at the point of the ſock will expoſe the plough to great riſks of being put out of order. When the upright edge ſtrikes a ſtone obliquely, eſpecially on the land-ſide, it muſt be violently twiſted round the point of the head; and, having but a moderate thickneſs at this part, may be broken or permanently twiſted. The plough will then be continually running out of its direction: and we apprehend that this defect cannot be amended without taking off the ſock and putting it in the fire. When a coulter is bent by the ſame cauſe, the ploughman can either rectify it by altering the wedging, or he can ſtraighten it in the field; and it muſt be obſerved, that the plough oppoſes much leſs reſiſtance to the derangement of this ſort of coulter than of the common one. In the common coulter the ſtrain does not ſo much tend to twiſt the plough round the line of its motion, as to preſs it wholly to landward. The reſiſtance to this is great; but a very moderate force will twiſt it round its line of motion. In either caſe, if the blow be given in that point of the coulter where the draught line croſſes it, there will be no twiſt of the whole plough, but the point of the plough will be forced horizontally to or from the land. When the blow is out of this line, the ſtrain tends to twiſt the beam or the plough. Experience will determine which of the two is the moſt hazardous. Theſe ploughs are made by Thomas Lindſay, Abbeyhill, Edinburgh, and models are to be ſeen in the hall of the Highland Society.

Plough-drill. See *Drill ſowing*, and Agriculture, p. 318; and Plate VII. and 2d Plate VII. In the Gentleman's Magazine for July 1793, p. 602, Mr Wickin's of Pondhead Lodge, New Foreſt, gives an account of a ſimplified drill-plough invented by himſelf. Its importance is increaſed, he thinks, by the cheapneſs and eaſy conſtruction of it, becauſe it can be uſed upon a ſmall ſcale by a ſingle man, and upon a larger ſcale by two men, or a man and boy; ſo that the inconvenience ſuffered by horſes trampling the ground, &c. is hereby avoided. To the drill for ſowing is occaſionally annexed a blade for hoeing between the rows: "the good effects of which (ſays Mr Wickins) are no leſs obvious from its nurturing the growth of the corn, and producing collateral ſhoots from the application of freſh ſoil, but alſo from its affording the means of extirpating the weeds which are ſo obnoxious to it." He informs us likewiſe, that his ſingle hand-drill hath been ſeen and approved by the Bath Society; and they have in conſequence been pleaſed to vote him an honorary and correſponding member. Since that time, however, he ſays, he has very materially improved and ſimplified it. Mr Wickins's deſcription of his invention is far from being accurate; and the drawing, of which there is an engraving in the ſame magazine, was taken when his machine was in its infant and leſs improved ſtate. He promiſes, however, further information in the Gentleman's Magazine, and he offers more particulars to ſuch agricultural people as ſhall deſire it. We are far from decidedly thinking that this plough-drill is a real improvement, or that it ever will come to be really and generally uſeful. We have ſeen ſo many of theſe and ſuch like improvements make a great noiſe for a while, and then fall into neglect, without having ever come into uſe, as makes us ſhy in forming opinions reſpecting the utility of thoſe inſtruments which are ſo often and ſo boldly obtruded on the world as the *ne plus ultra* of improvements in their ſeveral ſpheres. We think it our duty, however, to give every attempt at improvement, eſpecially in the uſeful arts, all the juſtice in our power; and, on this account, it has always been our cuſtom to lay before our readers ſuch claims to it as have occurred in the courſe of our work, whether thoſe claims appeared to ourſelves to be juſt or not.

PLOUGHMAN, the perſon who guides the plough in the operation of tilling.

PLOUGHING, in agriculture, the turning up the earth with a plough. See Agriculture, Part II. *paſſim.*

PLOVER, in ornithology, a ſpecies of Charadrius.

Theſe birds uſually fly in exceedingly large flocks in the places they frequent; people talk of 20,000 or 30,000 being ſeen in a flock. They generally come to England in September, and leave it about the end of March. In cold weather they are found very commonly on lands lying near the ſea in queſt of food; but in thaws and open ſeaſons they go higher up in the country.

They love to feed on ploughed lands, but never remain long at a time on them, for they are very cleanly in their nature; and the dirt which lodges on their beaks and feet give them ſo much uneaſineſs, that they fly to the neareſt water to waſh themſelves. When they rooſt, they do not go to trees or hedges; but ſit ſquatting on the ground like ducks or geeſe, far from trees or hedges, when the weather is calm; but when it is ſtormy, they often get under ſhelter. In wet weather they do not ſleep in the night at all, but run about picking up the worms as they crawl out of the ground; during this feeding they are continually making a ſmall cry, that ſerves to keep them together; and in the morning they take flight. If in their flight they ſpy any others on the ground, they call them up; and if they refuſe to come, the whole body deſcends to ſee what food there is in the place that detains them.

Plovers are very eaſily taken at the time of their firſt coming over, when they have not got any other birds mixed among them; but when they afterwards pick up the teal and other ſhy birds among them, it becomes more difficult. The beſt ſeaſon for taking them is in October, eſpecially in the beginning of that month: after this they grow timorous, and are not eaſily taken again till March, which is the time of their coupling. The ſevereſt froſts are not the beſt ſeaſon for taking them in neſt, but variable weather does better. The north-weſt wind is found diſadvantageous to the taking of them; and in general, great regard is to be paid to the courſe of the wind in the ſetting of the nets. All ſea-fowl fly againſt the wind when the land lies that way; and the nets for taking them are therefore to be placed in a proper direction accordingly.

PLOWDEN (Edmund), ſerjeant at law, was the ſon of Humphrey Plowden of Plowden in Shropſhire, of an ancient and genteel family. He was firſt a ſtudent of the univerſity of Cambridge, where he ſpent three years in the ſtudy of philoſophy and medicine.

He then removed to Oxford, where, having continued his former ſtudies about four years more, in 1552 he was admitted to the practice of phyſic and ſurgery; but probably finding the practice of the art of healing leſs agreeable than the ſtudy, he entered himſelf of the Middle Temple, and began to read law. Wood ſays, that in 1557 he was ſummer reader to that ſociety, and Lent-reader three years after, being then ſergeant and oracle of the law. He died in the year 1584, aged 67; and was buried in the Temple-church, near the north-wall, at the eaſt end of the choir. He married the daughter of William Sheldon of Boley in Worceſterſhire; by whom he had a ſon, who died ſoon after his father. He wrote, 1. Commentaries or reports of divers Caſes, &c. in the reigns of King Edw. VI. Queen Mary, and Queen Elizabeth; London, 1571, 78, 99, 1613, &c. Written in the old Norman language. 2. Queries, or a Moot-book of caſes, &c. tranſlated, methodized, and enlarged, by H. B. of Lincoln's-Inn; Lond. 1662, 8vo.

PLUCHE (Antony), born at Rheims in 1688, merited by his engaging manners and proficiency in the belles-lettres the appointment of humaniſt in the univerſity of that city. Two years after he obtained the profeſſor of rhetoric's chair, and was admitted into holy orders. The biſhop of Laon (Clermont) informed of his talents, offered him the direction of the college of his epiſcopal city. By his induſtry and ſuperior knowledge, a proper order and ſubordination ſoon took place in it; but ſome particular opinions reſpecting the affairs of the time diſturbed his tranquillity, and obliged him to quit his office. The intendant of Rouen, at the requeſt of the celebrated Rollin, entruſted him with the education of his ſon. Abbé Pluche having filled that place with ſucceſs and great honour to himſelf, left Rouen and went to Paris, where, by the patronage of ſome literary friends and his own excellent writings, he acquired a very diſtinguiſhed reputation for learning. He publiſhed, 1. *Le Spectacle de la Nature* (Nature Diſplayed), in 9 vols in 12mo. This work, which is equally inſtructive and entertaining, is written with perſpicuity and elegance; but the form of dialogue which he adopted has drawn him into the fault of being rather too prolix. The ſpeakers, who are the Prior, the Count, and Counteſs, are not diſtinguiſhed by any ſtriking feature; but they have all the common character, which is tolerably pleaſing, not excepting even that of the little chevalier De Brueil, who is, however a mere ſcholar. This is the opinion which Abbé Deſfontaines has formed of this work. Though the author has given the converſations a pretty ingenious turn, and even ſome vivacity, yet they now and then fall into the tone of the college. 2. *Hiſtoire du Ciel*, or Hiſtory of the Heavens, in 2 vols in 12mo. In this performance we find two parts almoſt independent of one another. The firſt contains ſome learned inquiries into the origin of the poetic heavens. It is nearly a complete mythology, founded upon ideas which are new and ingenious. The ſecond is the hiſtory of the opinions given by philoſophers reſpecting the formation of the world. The author ſhows the inutility, the inconſtancy, and uncertainty, of the moſt eſteemed ſyſtems; and concludes with pointing out the excellence and ſublime ſimplicity of the Moſaic account. Beſides a noble and well-turned expreſſion, we find in it an erudition which does not fatigue the mind. As to the foundation of the ſyſtem explained in the firſt part, though it appears extremely plauſible, we will not take upon us to ſay how far it is true: Voltaire called it *Fable du Ciel*, or a Fable of the Heavens. 3. *De linguaram Artificio*; a work which he tranſlated with this title, *La Mechanique des Langues*, in 12mo. In this treatiſe he propoſes a ſhort and eaſy method of learning languages, which is by the uſe of tranſlations inſtead of themes or exerciſes; and we muſt admit his reflections on that ſubject are both judicious and well expreſſed. 4. Harmony of the Pſalms and the Goſpel, or a Tranſlation of the Pſalms and Hymns of the church, which Notes relative to the Vulgate, the Septuagint, and Hebrew Text, printed at Paris in 1764, in 12mo. In 1749, Abbé Pluche retired to varenne St Maure, where he gave himſelf up entirely to devotion and ſtudy. Having become ſo deaf that he could not hear without the help of a trumpet, the capital afforded him very little entertainment. It was in this retreat that he died of an apoplexy on the 20th of November 1761, at the age of 73 years. He poſſeſſed thoſe qualities which form the ſcholar, the honeſt man, and the Chriſtian: temperate in his meals, true to his word, an affectionate parent, a ſenſible friend, and a humane philoſopher; he gave leſſons of virtue in his life as well as in his writings. His ſubmiſſion to all the dogmas of religion was very great. Some deiſts having been ſurpriſed that, in matters of faith, he ſhould think and ſpeak like the vulgar, his anſwer was, "I glory in doing ſo: It is infinitely more rational to believe the word of God, than to follow the glimmering lights of a reaſon which is limited and ſubject to error."

PLUG, certain pieces of timber, formed like the fruſtum of a cone, and uſed to ſtop the hauſe-holes and the breaches made in the body of a ſhip by cannon-balls; the former of which are called *hauſe-plugs*, and the latter *ſhot-plugs*, which are formed of various ſizes in proportion to the holes made by the different ſizes of ſhot, which may penetrate the ſhip's ſides or bottom in battle; accordingly they are always ready for this purpoſe.

PLUKENET (Leonard), a phyſician who flouriſhed in the reign of King Charles II. was one of the moſt excellent and laborious botaniſts of that or any other age. He was author of the *Phytographia Plucenetiana*, the *Almageſticum Britannicum*, and other works of the like kind, on which he ſpent the greateſt part of his life and fortune. His Phytography is mentioned with the higheſt encomiums in the Philoſophical tranſactions for February 1696-7. His *Opera Botanica*, with cuts, were printed at London in 6 vols folio, in 1720.

PLUM-TREE, in botany. See PRUNUS.

PLUMAGE, the feathers which ſerve birds for a covering. See ORNITHOLOGY, p. 506.

PLUMB-LINE, among artificers, denotes a perpendicular to the horizon; ſo called as being commonly erected by means of a plummet.

PLUMBAGO, LEAD-WORT; a genus of the monogynia order, belonging to the pentandria claſs of plants. There are four ſpecies; the moſt remarkable of which are the Europæa and Zeylonica. The firſt grows naturally in the ſouthern parts of Europe; and has a perennial root ſtriking deep in the ground. There are many ſlender channelled ſtalks, about three feet high, terminated by tufts of ſmall funnel-ſhaped flowers, of a blue or white colour. The ſecond grows naturally in

Plumbago,
Plumbery.

both the Indies. The upper part of the ſtalk and empalement are covered with a glutinous juice, which catches the ſmall flies that light upon it. The former ſpecies is propagated by parting the roots, and by ſeeds; but the latter is too tender to thrive in the open air in cold countries.

PLUMBAGO. See *Black-Lead*.

PLUMBERY, the art of caſting and working lead, and uſing it in building.

As this metal melts ſoon and with little heat, it is eaſy to caſt it into figures of any kind, by running it into moulds of braſs, clay, plaſter, &c. But the chief article in plumbery is ſheets and pipes of lead; and as theſe make the baſis of the plumber's work, we ſhall here give the proceſs of making them.

In caſting *ſheet-lead*, a table or mould is made uſe of, which conſiſts of large pieces of wood well jointed, and bound with bars of iron at the ends; on the ſides of which runs a frame conſiſting of a ledge or border of wood, three inches thick and four inches high from the mould, called the *ſharps*: The ordinary width of the mould, within theſe ſharps, is from four to five feet; and its length is 16, 17, or 18 feet. This ſhould be ſomething longer than the ſheets are intended to be, in order that the end where the metal runs off from the mould may be cut off, becauſe it is commonly thin or uneven, or ragged at the end. It muſt ſtand very even or level in breadth, and ſomething falling from the end in which the metal is poured in, viz. about an inch or an inch and a half in the length of 16 or 17 feet or more, according to the thinneſs of the ſheets wanted; for the thinner the ſheet, the more declivity the mould ſhould have. At the upper end of the mould ſtands the pan, which is a concave triangular priſm, compoſed of two planks nailed together at right angles, and two triangular pieces fittted in between them at the ends. The length of this pan is the whole breadth of the mould in which the ſheets are caſt; it ſtands with its bottom, which is a ſharp edge, on a form at the end of the mould, leaning with one ſide againſt it; and on the oppoſite ſide is a handle to lift it up by, to pour out the melted lead; and on that ſide of the pan next the mould are two iron-hooks to take hold of the mould, and prevent the pan from ſlipping while the melted lead is pouring out of it into the mould. This pan is lined on the inſide with moiſtened ſand, to prevent it from being fired by the hot metal. The mould is alſo ſpread over, about two inches thick, with ſand ſifted and moiſtened, which is rendered perfectly level by moving over it a piece of wood called a *ſtrike*, and ſmoothing it over with a ſmoothing plane, which is a plate of poliſhed braſs, about one-fourth of an inch thick and nine inches ſquare, turned up on all the four edges, and with a handle fitted on to the upper or concave ſide. The ſand being thus ſmoothed, it is fit for caſting ſheets of lead: but if they would caſt a ciſtern, they meaſure out the bigneſs of the four ſides; and having taken the dimenſions of the front or fore-part, make mouldings by preſſing long ſlips of wood, which contain the ſame mouldings, into the level ſand; and form the figures of birds, beaſts, &c. by preſſing in the ſame manner leaden figures upon it, and then taking them off, and at the ſame time ſmoothing the ſurface where any of the ſand is raiſed up by making theſe impreſſions upon it. The reſt of the operation is the ſame in caſting either ciſterns or plain ſheets of lead. But before we proceed to mention the manner in which that is performed, it will be neceſſary to give a more particular deſcription of the *ſtrike*. The ſtrike, then, is a piece of board about five inches broad, and ſomething longer than the breadth of the mould on the inſide; and at each end is cut a notch about two inches deep, ſo that when it is uſed it rides upon the ſharps with thoſe notches. Before they begin to caſt, the ſtrike is made ready by tacking on two pieces of an old hat on the notches, or by ſlipping a caſe of leather over each end, in order to raiſe the under ſide about one-eighth of an inch or ſomething more above the ſand, according as they would have the ſheet to be in thickneſs; then they tallow the under edge of the ſtrike, and lay it acroſs the mould. The lead being melted, it is put into the pan with ladles, in which, when there is a ſufficient quantity for the preſent purpoſe, the ſcum of the metal is ſwept off with a piece of board to the edge of the pan, letting it ſettle on the ſand, which is by this means prevented from falling into the mould at the pouring out of the metal. When the lead is cool enough, which muſt be regulated according to the thickneſs of the ſheets wanted, and is known by its beginning to ſtand with a ſhell or wall on the ſand round the pan, two men take the pan by the handle, or elſe one of them lifts it by the bar and chain fixed to a beam in the ceiling, and pour it into the mould, while another man ſtands ready with the ſtrike, and, as ſoon as they have done pouring in the metal, puts on the mould, ſweeps the lead forward, and draws the overplus into a trough prepared to receive it. The ſheets being thus caſt, nothing remains but to roll them up or cut them into any meaſure wanted: but if it be a ciſtern, it is bent into four ſides, ſo that the two ends may join the back, where they are ſoldered together; after which the bottom is ſoldered up.

Plumbery.

The method of caſting pipes without ſoldering. To make theſe pipes they have a kind of little mill, with arms or levers to turn it with. The moulds are of braſs, and conſiſt of two pieces, which open and ſhut by means of hooks and hinges, their inward caliber or diameter being according to the ſize of the pipe, uſually two feet and a half. In the middle is placed a core or round piece of braſs or iron, ſomewhat longer than the mould, and of the thickneſs of the inward diameter of the pipe. This core is paſſed through two copper rundles, one at each end of the mould, which they ſerve to cloſe; and to theſe is joined a little copper tube about two inches long, and of the thickneſs the leaden pipe is intended to be of. By means of theſe tubes, the core is retained in the middle of the cavity of the mould. The core being in the mould, with the rundles at its two ends, and the lead melted in the furnace, they take it up in a ladle, and pour it into the mould by a little aperture at one end, made in the form of a funnel. When the mould is full, they paſs a hook into the end of the core, and, turning the mill, draw it out; and then opening the mould, take out the pipe. If they deſire to have the pipe lengthened, they put one end of it in the lower end of the mould, and paſs the end of the core into it; then ſhut the mould again, and apply its rundle and tube as before, the pipe juſt caſt ſerving for a rundle, &c. at the other end. Things being thus replaced, they pour in freſh metal, and repeat the operation till they have got a pipe of the length required.

For making pipes of ſheet-lead, the plumbers have wooden cylinders, of the length and thickneſs required; and on theſe they form their pipes by wrapping the ſheet around them, and ſoldering up the edges all along them.

The lead which lines the Chineſe tea-boxes is reduced to a thinneſs which we are informed European plumbers cannot imitate. The following account of the proceſs by which the plates are formed was communicated to a writer in the Gentleman's Magazine by an intelligent mate of an Eaſt Indiaman. The caſter ſits by a pot containing the melted metal; and has two large ſtones, the under one fixed, the upper moveable, directly before him. He raiſes the upper ſtone by preſſing his foot upon the ſide of it, and with an iron ladle pours into the opening a proper quantity of the fluid metal. He then immediately lets fall the upper ſtone, and by that means forms the lead into a thin regular plate, which is afterwards cut into a proper ſhape. The ſurfaces of the ſtones, where they touch each other, are exactly ground together.

PLUMBUM, LEAD. See LEAD.

PLUMBUM Corneum, a combination of lead with the marine acid. See CHEMISTRY, n° 812.

PLUME, in botany, the bud or germ. See GEMMA.

PLUMIER (Charles), a learned Minim, born at Marſeilles, and one of the moſt able botaniſts of the 17th century. He was inſtructed by the famous Maignan, who taught him mathematics, turnery, the art of making ſpectacles, burning-glaſſes, microſcopes, and other works. He at length went to Rome to perfect himſelf in his ſtudies, and there applied himſelf entirely to botany under a ſkilful Italian. At his return to Provence, he ſettled in the convent at Bornes, a maritime place near Hieres, where he had the conveniency of making diſcoveries in the fields with reſpect to ſimples. He was ſome time after ſent by the French king to America, to bring from thence ſuch plants as might be of ſervice in medicine. He made three different voyages to the Antilles, and ſtopped at the iſland of St Domingo. The king honoured him with a penſion; and he at laſt ſettled at Paris. However, at the deſire of M. Fagon, he prepared to go a fourth time to America, to examine the tree which produces the Jeſuits bark; but died at the port of Santa Maria near Cadiz, in 1706. He wrote ſeveral excellent works; the principal of which are, 1. A volume of the Plants in the American Iſlands. 2. A treatiſe on the American Fern. 3. The Art of Turnery; a curious work embelliſhed with plates.

PLUMMET, PLUMB-*Rule* or *Plumb line*, an inſtrument uſed by carpenters, maſons, &c, in order to judge whether walls, &c. be upright planes, horizontal, or the like. It is thus called from a piece of lead, faſtened to the end of a chord, which uſually conſtitutes this inſtrument. Sometimes the ſtring deſcends along a wooden ruler, &c. raiſed perpendicularly on another; in which caſe it becomes a level.

PLUMMING, among miners, is the method of uſing a mine dial, in order to know the exact place of the work where to ſink down an air-ſhaft, or to bring an adit to the work, or to know which way the load inclines when any flexure happens in it.

It is performed in this manner: A ſkilful perſon with an aſſiſtant, and with pen, ink, and paper, and a long line, and a ſun-dial, after his gueſs of the place above ground deſcends into the adit or work, and there faſtens one end of the line to ſome fixed thing in it; then the incited needle is let to reſt, and the exact point where it reſts is marked with a pen: he then goes on farther in the line ſtill faſtened, and at the next flexure of the adit he makes a mark on the line by a knot or otherwiſe: and then letting down the dial again, he there likewiſe notes down that point at which the needle ſtands in this ſecond poſition. In this manner he proceeds, from turning to turning, marking down the points, and marking the line, till he comes to the intended place: this done, he aſcends and begins to work on the ſurface of the earth what he did in the adit, bringing the firſt knot in the line in ſuch a place where the mark of the place of the needle will again anſwer its pointing, and continues this till he come to the deſired place above ground, which is certain to be perpendicular over the part of the mine into which the air-ſhaft is to be ſunk.

PLUMOSE, ſomething formed in the manner of a feather, with a ſtem and fibres iſſuing from it on each ſide; ſuch are the antennæ of certain moths, butterflies, &c.

PLURAL, in grammar an epithet applied to that number of nouns and verbs which is uſed when we ſpeak of more than one thing. See GRAMMAR.

PLURALITY, a diſcrete quantity, conſiſting of two or a greater number of the ſame kind: thus we ſay, a plurality of gods, &c. See the article ASTRONOMY, n° 157, for the arguments both for and againſt a plurality of worlds.

PLURALITY of Benefices, or *Livings*, is where the ſame clerk is poſſeſſed of two or more ſpiritual preferments, with cure of ſouls. See BENEFICE.

The ſmallneſs of ſome benefices firſt gave riſe to pluralites; for an eccleſiaſtic, unable to ſubſiſt on a ſingle one, was allowed to hold two; and at length the number increaſed without bounds. A remedy was attempted for this abuſe at the council of Lateran under Alexander III. and Innocent III. in the year 1215, when the holding more than one benefice was forbid by a canon under the penalty of deprivation; but the ſame canon granting the pope a power to diſpenſe with it in favour of perſons of diſtinguiſhed merit, the prohibition became almoſt uſeleſs. They were alſo reſtrained by ſtatute 21 Hen. VIII. cap. 13. which enacts, that if any perſon having one benefice with cure of ſouls, of the yearly value of 8l. or above (in the king's books), accept any other with cure of ſouls, the firſt ſhall be adjudged in law to be void, &c. though the ſame ſtatute provides for diſpenſation in certain caſes.

In England, in order to procure a diſpenſation, the preſentee muſt obtain of the biſhop, in whoſe dioceſe the livings are, two certificates of the values in the king's books, and the reputed values and diſtance; one for the archbiſhop, and the other for the lord-chancellor. And if the livings lie in two dioceſes, then two certificates of the ſame kind are to be obtained from each biſhop. He muſt alſo ſhow the archbiſhop his preſentation to the ſecond living; and bring with him two teſtimonials from the neighbouring clergy concerning his behaviour and converſation, one for the archbiſhop and the other for the lord-chancellor; and he muſt alſo ſhow the archbiſhop his letters of orders, and a certificate of his having taken the degree of maſter of arts at the leaſt, in one of the univerſities of this realm, under the hand of the regiſter. And if he be not doctor or bachelor of divinity, nor doctor nor bachelor of law, he is to procure a qualification of a chaplain, which is to be duly regiſtered in the faculty office, in order to be tendered to the archbiſhop, according to the ſtatute. And if he hath taken any of the aforeſaid degrees, which the ſtatute allows as qualifications, he is to procure a certificate thereof as already mentioned, and to ſhow the ſame to the archbiſhop; after which his diſpenſation is made out at the faculty office, where he gives ſecurity according to the direction of the canon. He muſt then repair to the lord-chancellor for confirmation under the broad ſeal; and he muſt apply to the biſhop of the dioceſe where the living lies for his admiſſion and inſtitution. By the ſeveral ſtamp acts, for every ſkin, or paper, or parchment, &c. on which any diſpenſation to hold two eccleſiaſtical dignities or benefices, or a dignity and a beneficence, ſhall be engroſſed or written, there ſhall be paid a treble 40 s. ſtamp duty.

We have alſo a regulation in regard to pluralities; but it is often diſpenſed with; for, by the faculty of diſpenſation, a pluraliſt is required, in that benefice from which he ſhall happen to the moſt abſent, to preach 13 ſermons every year, and to exerciſe hoſpitility for two months yearly.

In Germany the pope grants diſpenſations for poſſeſſing a plurality of benefices, on pretence that the eccleſiaſtical princes there need large revenues to bear up againſt the Proteſtant princes.

PLUS, in algebra, a character marked thus +, uſed for the ſign of addition. See ALGEBRA, p. 400, and *NEGATIVE Sine*.

PLUSH, in commerce, &c. a kind of ſtuff, having a ſort of velvet knap or ſhag on one ſide, compoſed regularly of a woof of a ſingle woollen thread and a double warp; the one wool, of two threads twiſted; the other goats or camels hair; though there are ſome pluſhes entirely of worſted, and others compoſed wholly of hair.

PLUTARCH, a great philoſopher and hiſtorian of antiquity, who lived from the reign of Claudius to that of Hadrian, was born at Chæronea, a ſmall city of Bœotia in Greece. Plutarch's family was ancient in Chæronea: his grandfather Lampiras was eminent for his learning and a philoſopher; and is often mentioned by Plutarch in his writings, as is alſo his father. Plutarch was initiated early in ſtudy, to which he was naturally inclined; and was placed under the care of Ammonius, an Egyptian, who, having taught philoſophy with great reputation at Alexandria, from thence travelled into Greece, and ſettled at Athens. Under this maſter he made great advances in knowledge; and like a thorough philoſopher, more apt to regard things than words, he purſued this knowledge to the neglect of languages. The Roman language at that time was not only the language of Rome, but of Greece alſo; and much more uſed there than the French is now in England. Yet he was ſo far from regarding it then, that, as we learn from himſelf, he became not converſant in it till the declenſion of his life; and, though he is ſuppoſed to have reſided in Rome near 40 years at different times, yet he never ſeems to have acquired a competent ſkill in it. But this was not the worſt: he did not cultivate his mother-tongue with any great exactneſs; and hence that harſhneſs, inequality, and obſcurity in his ſtyle, which has ſo frequently and ſo juſtly been complained of.

After he was principled and grounded by Ammonius, having an inſatiable thirſt for knowledge, he reſolved to travel. Egypt was at that time, as formerly it had been, famous for learning; and probably the myſteriouſneſs of their doctrine might tempt him, as it had tempted Pythagoras and others, to go and converſe with the prieſthood of that country. This appears to have been particularly his buſineſs, by his treatiſe *Of Iſis and Oſiris*: in which he ſhows himſelf verſed in the ancient theology and philoſophy of the wiſe men. From Egypt he returned into Greece; and viſiting in his way all the academies and ſchools of the philoſophers, gathered from them many of thoſe obſervations with which he has abundantly enriched poſterity. He does not ſeem to have been attached to any particular ſect, but culled from each of them whatever he thought excellent and worthy to be regarded. He could not bear the paradoxes of the Stoics, but yet was more averſe from the impiety of the Epicureans: in many things he followed Ariſtotle; but his favourites were Socrates and Plato, whoſe memory he revered ſo highly, that he annually celebrated their birth-days with much ſolemnity. Beſides this, he applied himſelf with extreme diligence to collect not only all books that were excellent in their kind, but alſo all the ſayings and obſervations of wiſe men which he had heard in converſation or had received from others by tradition; and likewiſe to conſult the records and public inſtruments preſerved in cities which he had viſited in his travels. He took a particular journey to Sparta, to ſearch the archives of that famous commonwealth, to underſtand thoroughly the model of their ancient government, the hiſtory of their legiſlators, their kings, their ephori; and digeſted all their memorable deeds and ſayings with much care. He took the ſame methods with regard to many other commonwealths; and thus was enabled to leave us in his works ſuch a rich cabinet of obſervation upon men and manners, as, in the opinion of Montaigne and Bayle, have rendered him the moſt valuable author of antiquity.

The circumſtances of Plutarch's life are not known, and therefore cannot be related with any exactneſs. According to the learned Fabricius, he was born under Claudius, 50 years after the Chriſtian era. He was married to a moſt amiable woman of his own native town, whoſe name, according to the probable conjecture of Rualdus, was Timoxene, and to whoſe ſenſe and virtue he has borne the moſt affectionate teſtimony in his moral works. He had ſeveral children, and among them two ſons; one called *Plutarch* after himſelf, the other *Lamprias* in memory of his grandfather. Lamprias was he, of all his children, who ſeems to have inherited his father's philoſophy; and to him we owe the table or catalogue of Plutarch's writings, and perhaps alſo his apophthegms. He had a nephew, Sextus Chæroneus, who taught the learned emperor Marcus Aurelius the Greek tongue, and was much honoured by him. Some think, that the critic Longinus was of his family; and Apuleius, in the firſt book of his Metamorphoſes, affirms himſelf to be deſcended from him.

On what occaſion, and at what time of his life, he went to Rome, how long he lived there, and when he finally returned to his own country, are all uncertain. It is probable, that the fame of him went thither before him, not only becauſe he had publiſhed ſeveral of his works, but becauſe immediately upon his arrival, as there is reaſon to believe, he had a great reſort of the Roman nobility to hear him: for he tells us himſelf, that he was ſo taken up in giving lectures of philoſophy to the great men of Rome, that he had not time to make himſelf maſter of the Latin tongue, which is one of the firſt things that would naturally have engaged his attention. It appears that he was ſeveral times at Rome; and perhaps one motive to his inhabiting there was the intimacy he had contracted in ſome of theſe journeys with Soſſius Senecio, a great and worthy man, who had been four times conſul, and to whom Plutarch has dedicated many of his lives. But the great inducement which carried him firſt to Rome was undoubtedly that which had carried him into ſo many other parts of the world; namely, to make obſervations upon men and manners, and to collect materials for writing the lives of the Roman worthies, in the ſame manner as he had already written thoſe of the Grecian: and accordingly he not only converſed with all the living, but ſearched the records of the Capitol, and of all the libraries. Not but, as we learn from Suidas, he was intruſted alſo with the management of public affairs in the empire, during his reſidence in the metropolis. "Plutarch (ſays he) lived in the time of Trajan, who beſtowed on him the conſular ornaments, and alſo cauſed an edict to be paſſed, that the magiſtrates or officers of Illyria ſhould do nothing in that province without his knowledge and approbation."

When and how he was made known to Trajan is likewiſe uncertain: but it is generally ſuppoſed that Trajan, a private man when Plutarch firſt came to Rome, was, among other nobility, one of his auditors. It is alſo ſuppoſed, that this wiſe emperor made uſe of him in his councils; at leaſt, much of the happineſs of his reign has been imputed to Plutarch. Fabricius aſſerts that he was Trajan's preceptor, and that he was raiſed to the conſular dignity by him, and made procurator of Greece in his old age by the emperor Adrian. We are equally at a loſs concerning the time of his abode in the imperial city; which, however, at different times, is not imagined to fall much ſhort of 40 years. The deſire of viſiting his native country, ſo natural to all men, and eſpecially when growing old, prevailed with him at length to leave Italy: and at his return he was unanimouſly choſen archon or chief magiſtrate of Chæronea, and not long after admitted into the number of the Delphic Apollo's prieſts. We have no particular account of his death, either as to the manner of it or the year; only it is evident that he lived, and continued his ſtudies, to a good old age. The moſt probable conjecture is that of Fabricius, who ſays he died in the fifth year of Adrian at the age of 70.

His works have been divided, and they admit of a pretty equal diviſion, into Lives and Morals: the former of which, in his own eſtimation, were to be preferred as more noble than the latter. His ſtyle, as we have already obſerved, has been excepted to with ſome reaſon: he has alſo been criticiſed for ſome miſtakes in Roman antiquities, and for a little partiality to the Greeks. On the other hand, he has been juſtly praiſed for the copiouſneſs of his fine ſenſe and learning, for his integrity, and for a certain air of goodneſs which appears in all he wrote. His buſineſs was not to pleaſe the ear, but to inſtruct and charm the mind; and in this none ever went beyond him. Of his moral writings it is to be regretted that we have no elegant Engliſh tranſlation. Even his Lives were chiefly known to the Engliſh reader by a motley and miſerable verſion, till a new one executed with fidelity and ſpirit was preſented to the public by the Langhornes in 1770. On the whole, it is to be wiſhed that this moſt amiable moraliſt and biographer had added a life of himſelf to thoſe which he has given to the world of others, as the particulars which other writers have preſerved of his perſonal hiſtory are very doubtful and imperfect.

PLUTO, in Pagan worſhip, the king of the infernal regions, was the ſon of Saturn and Ops, and the brother of Jupiter and Neptune. This deity finding himſelf childleſs and unmarried, mounted his chariot to viſit the world; and arriving in Sicily, fell in love with Proſerpine, whom he ſaw gathering flowers with her companions in the valley of Enna, near mount Ætna; when, forcing her into his chariot, he drove her to the river Chemarus, through which he opened himſelf a paſſage back to the realms of night. See CERES and PROSERPINE.

Pluto is uſually repreſented in an ebony chariot drawn by four black horſes; ſometimes holding a ſceptre, to denote his power; at others a wand, with which he drives away the ghoſts; and at others, ſome keys, to ſignify that he had the keys of death. Homer obſerves, that his helmet had the quality of rendering the wearer inviſible, and that Minerva borrowed it in order to be concealed from Mars when ſhe fought againſt the Trojans. Pluto was greatly revered both by the Greeks and Romans, who erected temples and altars to him. To this god ſacrifices were offered in the night, and it was not lawful to offer them by day.

PLUTUS, in Pagan worſhip, the god of riches, is frequently confounded with Pluto. He was repreſented as appearing lame when he approached, and with wings at his departure; to ſhow the difficulty of amaſſing wealth, and the uncertainty of its enjoyment. He was alſo frequently repreſented blind, to ſhow that he often beſtowed his favours on the moſt unworthy, and left in neceſſity thoſe who had the greateſt merit.

PLUVIALIS. See CHARADIUS, n° 7.

PLUVIUS, a ſurname of Jupiter. He was invoked by that name among the Romans whenever the earth was parched up by continual heat, and was in want of refreſhing rains. He had an altar in the temple on the capitol.

PLYERS, in fortification, denote a kind of balance uſed in raiſing or letting down a draw-bridge. They conſiſt of two timber levers, twice as long as the bridge they lift, joined together by other timbers framed in the form of a St Andrew's croſs to counterpoiſe them. They are ſupported by two upright jambs, on which they ſwing; and the bridge is raiſed or let down by means of chains joining the ends of the plyers and bridge.

PLYING, in the ſea language, the act of making, or endeavouring to make, a progreſs againſt the direction of the wind. Hence a ſhip that advances well in her courſe in this manner of ſailing, is ſaid to be a good plyer.

Plymouth.

plyer. See the articles Beating, Pitching, and Tacking.

PLYMOUTH, a town of Devonſhire, in England, about 215 miles from London, ſtands between the rivers Plym and Tamar, juſt before they fall into the Britiſh Channel. From a mere fiſhing village it has become one of the largeſt towns in the county; and in one of the chief magazines in the kingdom, on account of its port, which is one of the ſafeſt in England, and which is ſo large as to be able to contain 1000 ſail. It is defended by ſeveral different forts, mounting altogether nearly 300 guns; of which the chief is the Royal Citadel erected in the reign of Charles II. oppoſite to St Nicholas Iſland, which is within the circuit of its walls, and contains a large ſtore-houſe and five regular baſtions. In time of war the outward-bound convoys generally rendezvous at Plymouth, and homeward-bound ſhips generally put in to provide pilots up the Channel. It is alſo a great place of reſort for men of war that are wind-bound.

The mouth of the Tamar is called Ham-Ooze, and that of Plym Catwater, which are both commanded by the caſtle of St Nicholas Iſland. About two miles up the mouth of the Tamar there are four docks, two of which were built in the reign of William III. one wet and the other dry, and two which have been built ſince. They have every conveniency for building or repairing ſhips, and one of them is hewn out of a mine of ſlate and lined with Portland ſtone. This town enjoys a pilchard fiſhery of conſiderable importance, and carries on an extenſive trade with Newfoundland and the Straits. There is a cuſtomhouſe in it; and though there are two churches (and beſides ſeveral meeting-houſes), yet each church has ſo large a cure of ſouls, that the pariſh clerks were till very lately in deacon's orders, to enable them to perform all the occaſional and other offices. The ſeat-rents are given to the poor. The lecturers are choſen every three years by the corporation, which was conſtituted by Henry VI. and conſiſts of a mayor, 12 aldermen, and 24 common-council men. The mayor is elected by a jury of 36 perſons, choſen by four others, two of whom are appointed by the mayor and aldermen, and the other two by the common-council. There is alſo a recorder, and a town-clerk, whoſe place is very profitable. The town conſiſts of four diviſions, which were anciently governed by four captains, each of whom had three conſtables under him. It is well ſupplied with freſh water, which was brought from the diſtance of ſeven miles, by Sir Francis Drake a native of the town. The toll of the markets, and of the cotton, yarn, &c. with the profit of the mill, which is very conſiderable, belongs to the corporation, as do the revenues of the ſhambles, which are farmed out for the mayor's kitchen. There is a charity-ſchool in Plymouth, four hoſpitals, and a workhouſe, in all which 100 poor children are clothed, fed, and taught; and there are two printing-houſes. To one of the hoſpitals Colonel Jory gave a charity for 12 poor widows, as he did a mace worth 120l. to be carried before the mayor, and ſix good bells, valued at 500l. to Charles-Church, ſo called from the kings in whoſe reigns it was begun and finiſhed. In the entrance of the bay lies the famous Edyſtone-rock, which is covered at high-water, and on which the ingenious Mr Winſtanley built a light-houſe, that was blown down in the terrible hurricane of Nov. 27th 1703, and himſelf, with others that were with him in it, never more heard of. However another was erected in the room of it, by the corporation of the Trinity-houſe, in purſuance of an act of the 5th of Queen Anne, which was deſtroyed by an accidental fire Dec. 4th. 1755, but rebuilt in 1759: which alſo was burnt down, and rebuilt in the year 1770. In the reign of Edward III. the French landed, and burnt part of the town, but were ſoon repulſed by Hugh Courtenay earl of Devon. In the reign of Henry IV. the French landed here again, and burnt 600 houſes. Between this town and the ſea is a hill called the Haw, which has a delightful plain on the top, having a pleaſant proſpect all round it, and a good land-mark for the uſe of mariners. The liſt of parliament-men for this borough, formerly divided into two parts, by the names of Sutton-Valtort and Sutton-Prior, commences the 26th of Edward I. and continues to the 14th of Edward III. after which we find no return made for it till the 20th of Henry VI. when the privilege was renewed. On the Haw is a fort, which at once awes the town and defends the harbour. Here is a ferry over the Tamar, called Cromwell or Crimble Paſſage, the weſt ſide of which is called Weſtone-Houſe, and is in Devonſhire, though moſt of the pariſh wherein it ſtands is in Cornwall. In April 1759 the parliament granted 25,159l. for the better fortifying the town and dock of Plymouth; which was viſited by George III. with the Queen, &c. in Auguſt 1789. N. Lat. 50. 26. W. Long. 4. 15.

Plymouth, Plynteri.

Plymouth, in New England, a ſea-port town, and capital of the county of the ſame name, in the province of Maſſachuſets Bay, in North America. It is remarkable for having been the firſt ſettlement in New England, and for having had the firſt place of worſhip. It is ſeated at the ſouth end of Plymouth Bay. W. Long. 70. 10 N. Lat. 41. 58.

PLYNTERIA, a Grecian feſtival in honour of Aglauros, or rather of Minerva, who received from the daughter of Cecrops the name of Aglauros. The word is derived from πλυνειν, *lavare*, becauſe during the ſolemnity they undreſſed the ſtatue of the goddeſs and waſhed it. The day on which it was obſerved was looked upon as unfortunate and inauſpicious; and therefore no perſon was permitted to appear in the temples, as they were purpoſely ſurrounded with ropes. The arrival of Alcibiades in Athens that day was thought very unfortunate, but the ſucceſs that ever after attended him proved it to be otherwiſe. It was cuſtomary at this feſtival to bear in proceſſion a cluſter of figs; which intimated the progreſs of civilization among the firſt inhabitants of the earth, as figs ſerved them for food after they had found a diſlike for acorns.

PNEUMATICS.

Definition of the term,

THIS term is reſtricted, in the preſent habits of our language, to that part of natural philoſophy which treats of the mechanical properties of elaſtic fluids. The word, in its original meaning, expreſſes a quality of air, or more properly of breath. Under the article Physics we obſerved, that in a great number of languages the term uſed to expreſs breath was alſo one of the terms uſed to expreſs the animating principle, nay, the intellectual ſubſtance, the ſoul. It has been perhaps owing to ſome attention to this chance of confuſion that our philoſophers have appropriated the term Pneumatics to the ſcience of the mechanical properties of air, and Pneumatology to the ſcience of the intellectual phenomena conſequent on the operations or affections of our thinking principle.

2
Extent of the ſcience.

We have extended (on the authority of preſent cuſtom) the term Pneumatics to the ſtudy of the mechanical properties of all elaſtic or ſenſibly compreſſible fluids, that is, of fluids whoſe elaſticity and compreſſibility become an intereſting object of our attention; as the term Hydrostatics is applied to the ſtudy of the mechanical properties of ſuch bodies as intereſt us by their fluidity or liquidity only, or whoſe elaſticity and compreſſibility are not familiar or intereſting, though not leſs real or general than in the caſe of air and all vapours.

3
No preciſe limit to the different claſſes of bodies.

We may be indulged in the obſervation by the bye that there is no preciſe limit to the different claſſes of natural bodies with reſpect to their mechanical properties. There is no ſuch thing as a body perfectly hard, perfectly ſoft, perfectly elaſtic, or perfectly incompreſſible. All bodies have ſome degree of elaſticity intermixed with ſome degree of ductility. Water, mercury, oil, are compreſſible; but their compreſſibility need not be attended to in order perfectly to underſtand the phenomena conſequent on their materiality, fluidity, and gravity. But if we neglect the compreſſibility of air, we remain ignorant of the cauſe and nature of its moſt intereſting phenomena, and but imperfectly informed with reſpect to thoſe in which its elaſticity has no ſhare; and it is convenient to attend to this diſtinction in our reſearches, in order to underſtand thoſe phenomena which depend ſolely or chiefly on compreſſibility and elaſticity. This obſervation is important; for here elaſticity appears in its moſt ſimple form, unaccompanied with any other mechanical affection of matter (if we except gravity), and lies moſt open to our obſervation, whether employed for inveſtigating the nature of this very property of bodies, or for explaining its mode of action. We ſhall even find that the conſtitution of an avowedly elaſtic fluid, whoſe compreſſibility is ſo very ſenſible, will give us the diſtincteſt notions of fluidity in general, and enable us to underſtand its *characteriſtic appearances*, by which it is diſtinguiſhed from ſolidity, namely, the *equable* diſtribution of preſſure thro' all its parts in every direction, and the horizontality which its ſurface aſſumes by the action of gravity: phenomena which have been aſſumed as equivalent to the definition of a perfect fluid, and from which all the laws of hydroſtatics and hydraulics have been derived. And theſe laws have been applied to the explanation of the phenomena around us; and water, mercury, oil, &c. have been denominated fluid only becauſe their appearances have been found to tally exactly with theſe conſequences of this definition, while the definition itſelf remains in the form of an aſſumption, unſupported by any other proof of its obtaining in nature. A real mechanical philoſopher will therefore attach himſelf with great eagerneſs to this property, and conſider it as an introduction to much natural ſcience.

4
Air the moſt familiar compreſſible fluid.

Of all the ſenſibly compreſſible fluids air is the moſt familiar, was the firſt ſtudied, and the moſt minutely examined. It has therefore been generally taken as the example of their mechanical properties, while thoſe mechanical properties which are peculiar to any of them, and therefore characteriſtic, have uſually been treated as an appendix to the general ſcience of pneumatics. No objection occurs to us againſt this method, which will therefore be adopted in treating this article.

5
Different properties of it.

But although the mehcanical properties are the proper ſubjects of our conſideration, it will be impoſſible to avoid conſidering occaſionally properties which are more of a chemical nature; becauſe they occaſion ſuch modifications of the mechanical properties as would frequently be unintelligible without conſidering them in conjunction with the other; and, on the other hand, the mechanical properties produce ſuch modifications of the properties merely chemical, and of very intereſting phenomena conſequent on them, that theſe would often paſs unexplained unleſs we give an account of them in this place.

6
Mechanical properties.

By *mechanical properties* we would be underſtood to mean ſuch as produce, or are connected with, ſenſible changes of motion, and which indicate the preſence and agency of moving or mechanical powers. They are therefore the ſubject of mathematical diſcuſſion; admitting of meaſure, number, and direction, notions purely mathematical.

We ſhall therefore begin with the conſideration of air.

7
What is air?

It is by no means an idle queſtion, "*What is this air of which ſo much is ſaid and written?*" We ſee nothing, we feel nothing. We find ourſelves at liberty to move about in any direction without any let or hindarance. Whence then the aſſertion, that we are ſurrounded with a *matter* called air? A very few ſimple obſervations and experiments will ſhow us that this aſſertion is well founded.

8
Proofs that it is matter.
Plate cccxcix.

We are accuſtomed to ſay, that a veſſel is empty when we have poured out of it the water which it contained. Take a cylindrical glaſs jar (fig. 1.), having a ſmall hole in its bottom; and having ſtopped this hole, fill the jar with water, and then pour out the water, leaving the glaſs empty, in the common acceptation of the word. Now, throw a bit of cork, or any light body, on the ſurface of water in a ciſtern: cover this with the glaſs jar held in the hand with its bottom upwards, and move it downwards, keeping it all the while in an upright poſition. The cork will continue to float on the ſurface of the water in the inſide of the glaſs, and will moſt diſtinctly ſhow whereabouts that ſurface is. It will thus be ſeen, that the water within the glaſs has its ſurface conſiderably lower than that of the ſurrounding water; and however deep we immerge the glaſs, we ſhall find that the water will never riſe in the inſide of it ſo as to fill it. If plunged to the depth of 32 feet, the water will only half fill it; and yet the acknowledged laws of hydroſtatics tell us, that the water would fill the glaſs if there were nothing to hinder it. There is therefore ſomething already within the glaſs which prevents the water from getting into it; manifeſting in this manner the moſt diſtinctive property of matter, viz. the hindering other matter from occupying the ſame place at the ſame time.

9 Poſſeſſed of impulſive force, While things are in this condition pull the ſtopper out of the hole in the bottom of the jar, and the water will inſtantly riſe in the inſide of the jar, and ſtand at an equal height within and without. This is juſtly aſcribed to the eſcape through the hole of the *matter* which formerly obſtructed the entry of the water: for if the hand be held before the hole, a puff will be diſtinctly felt, or a feather held there will be blown aſide; indicating in this manner that what prevented the entry of the water, and now eſcapes, poſſeſſes another characteriſtic property of matter, *impulſive force*. The materiality is concluded from this appearance in the ſame manner that the materiality of water is concluded from the impulſe of a jet from a pipe. We alſo ſee the mobility of the formerly pent up, and now liberated, ſubſtance, in conſequence of external preſſure. viz. the preſſure of the ſurrounding water.

10 Impenetrability, Alſo, if we take a ſmooth cylindrical tube, ſhut at one end, and fit a plug or cork to its open end, ſo as to ſlide along it, but ſo tightly as to prevent all paſſage by its ſides; and if the plug be well ſoaked in greaſe, we ſhall find that no force whatever can puſh it to the bottom of the tube. There is therefore *ſomething* within the tube preventing by its impenetrability the entry of the plug, and therefore poſſeſſing this characteriſtic of matter.

11 Elaſticity. In like manner, if, after having opened a pair of common bellows, we ſhut up the nozzle and valve hole, and try to bring the boards together, we find it impoſſible. There is ſomething included which prevents this, in the ſame manner as if the bellows were filled with wool; but on opening the nozzle we can eaſily ſhut them, viz. by expelling this ſomething; and if the compreſſion is forcible, the ſomething will iſſue with conſiderable force, and very ſenſibly impel any thing in its way.

12 Inertia, and mobility. It is not accurate to ſay, that we move about without any obſtruction; for we find, that if we endeavour to move a large fan with rapidity, a very ſenſible hinderance is perceived, and that a very ſenſible force muſt be exerted; and a ſenſible wind is produced, which will agitate the neighbouring bodies. It is therefore juſtly concluded that the motion is poſſible only in conſequence of having driven this obſtructing ſubſtance out of the way; and that this impenetrable, reſiſting, moveable, impelling ſubſtance, is *matter*. We perceive the perſeverance of this matter in its ſtate of reſt when we wave a fan, in the ſame manner that we perceive the *inertia* of water when we move a paddle through it. The effects of wind in impelling our ſhips and mills, in tearing up trees, and overturning buildings, are equal indications of its perſeverance in a ſtate of motion.

To this matter, when at reſt, we give the name AIR; and when it is in motion we call it WIND. 13

It is therefore a material fluid, Air, therefore, is a material fluid: a fluid, becauſe its parts are eaſily moved, and yield to the ſmalleſt inequality of preſſure.

14 Heavy, and Air poſſeſſes ſome others of the very general, though not eſſential, properties of matter. It is heavy. This appears from the following facts.

1. It always accompanies this globe in its orbit round the ſun, ſurrounding it to a certain diſtance, under the name of the ATMOSPHERE, which indicates the being connected with the earth by its general force of gravity. It is chiefly in conſequence of this that it is continually moving round the earth from eaſt to weſt; forming what is called the trade-wind, to be more particularly conſidered afterwards. All that is to be obſerved on this ſubject at preſent is, that, in conſequence of the diſturbing force of the ſun and moon, there is an accumulation of the air of the atmoſphere, in the ſame manner as of the waters of the ocean, in thoſe parts of the globe which have the moon near their zenith or nadir: and as this happens ſucceſſively, going from the eaſt to the weſt (by the rotation of the earth round its axis in the oppoſite direction), the accumulated air muſt gradually flow along to form the elevation. This is chiefly to be obſerved in the torrid zone; and the generality and regularity of this motion are greatly diſturbed by the changes which are continually taking place in different parts of the atmoſphere from cauſes which are not mechanical.

15 Supports the cloud 2. It is in like manner owing to the gravity of the air that it ſupports the clouds and vapours which we ſee conſtantly floating in it. We have even ſeen bodies of no inconſiderable weight float, and even riſe, in the air. Soap bubbles, and balloons filled with inflammable gas, riſe and float in the ſame manner as a cork riſes in water. This phenomenon proves the weight of the air in the ſame manner that the ſwimming of a piece of wood indicates the weight of the water which ſupports it.

16 Familiar proofs of its weight. 3. But we are not left to theſe refined obſervations for the proof of the air's gravity. We may obſerve familiar phenomena, which would be immediate conſequences of the ſuppoſition that air is a heavy fluid, and, like other heavy fluids, preſſes on the outſides of all bodies immerſed in or ſurrounded by it. Thus, for inſtance, if we ſhut the nozzle and valve hole of a pair of bellows after having ſqueezed the air out of them, we ſhall find that a very great force, even ſome hundred pounds is neceſſary for ſeparating the boards. They are kept together by the preſſure of the heavy air which ſurrounds them in the ſame manner, as if they were immerſed in water. In like manner, if we ſtop the end of a ſyringe after its piſton has been preſſed down to the bottom, and then attempt to draw up the piſton, we ſhall find a conſiderable force neceſſary, viz. about 15 or 16 pounds for every ſquare inch of the ſection of the ſyringe. Exerting this force, we can draw up the piſton to the top, and we can hold it there; but the moment we ceaſe acting, the piſton ruſhes down and ſtrikes the bottom. It is called a ſuction, as we feel ſomething as it were drawing in the piſton; but it is really the weight

of the incumbent air preſſing it in. And this obtains in every poſition of the ſyringe; becauſe the air is a fluid, and preſſes in every direction. Nay, it preſſes on the ſyringe as well as on the piſton; and if the piſton be hung by its ring on a nail, the ſyringe requires force to draw it down (juſt as much as to draw the piſton up); and if it be let go, it will ſpring up, unleſs loaded with at leaſt 15 pounds for every ſquare inch of its tranſverſe ſection (ſee fig. 2.)

Plate cccxcix.

17 It may even be weighed.

4. But the moſt direct proof of the weight of the air is had by weighing a veſſel empty of air, and then weighing it again when the air has been admitted; and this, as it is the moſt obvious conſequence of its weight has been aſſerted as long ago as the days of Ariſtotle. He ſays (περί ουρανου, iv. 4.), That all bodies are heavy in their place except fire: even air is heavy; for a blown bladder is heavier than when it is empty. It is ſomewhat ſurpriſing that his followers ſhould have gone into the oppoſite opinion, while profeſſing to maintain the doctrine of their leader. If we take a very large and limber bladder, and ſqueeze out the air very carefully, and weigh it, and then fill it till the wrinkles juſt begin to diſappear, and weigh it again, we ſhall find no difference in the weight. But this is not Ariſtotle's meaning; becauſe the bladder, conſidered as a veſſel, is equally full in both caſes, its dimenſions being changed. We cannot take the air out of a bladder without its immediately collapſing. But what would be true of a bladder would be equally true of any veſſel. Therefore, take a round veſſel A (fig. 3.), fitted with a ſtopcock B, and ſyringe C. Fill the whole with water, and preſs the piſton to the bottom of the ſyringe. Then keeping the cock open, and holding the veſſel upright, with the ſyringe undermoſt, draw down the piſton. The water will follow it by its weight, and leave part of the veſſel empty. Now ſhut the cock, and again puſh up the piſton to the bottom of the ſyringe; the water eſcapes through the piſton valve, as will be explained afterward: then opening the cock, and again drawing down the piſton, more water will come out of the veſſel. Repeat this operation till all the water have come out. Shut the cock, unſcrew the ſyringe, and weigh the veſſel very accurately. Now open the cock, and admit the air, and weigh the veſſel again, it will be found heavier than before, and this additional weight is the weight of the air which fills it; and it will be found to be 523 grains, about an ounce and a fifth avoirdupoiſe, for every cubic foot that the veſſel contains. Now ſince a cubic foot of water would weigh 1000 ounces, this experiment would ſhow that water is about 840 times heavier than air. The moſt accurate judgment of this kind of which we have met with an account is that recorded by Sir George Shuckbourgh, which is in the 67th vol. of the Philoſophical Tranſactions, p. 560. From this it follows, that when the air is of the temperature 53, and the barometer ſtands at $29\frac{3}{4}$ inches, the air is 836 times lighter than water. But the experiment is not ſuſceptible of ſufficient accuracy for determining the exact weight of a cubic foot of air. Its weight is very ſmall; and the veſſel muſt be ſtrong and heavy, ſo as to overload any balance that is ſufficiently nice for the experiment.

18 The moſt convenient method of doing this.

To avoid this inconvenience, the whole may be weighed in water, firſt loading the veſſel ſo as to make it preponderate an ounce or two in the water. By this means the balance will be loaded only with this ſmall preponderancy. But even in this caſe there are conſiderable ſources of error, ariſing from changes in the ſpecific gravity of the water and other cauſes. The experiment has often been repeated with this view, and the air has been found at a medium to be about 840 times as light as water, but with great variations, as may be expected from its very heterogeneous nature, in conſequence of its being the menſtruum of almoſt every fluid, of all vapours, and even of moſt ſolid bodies; all which it holds in ſolution, forming a fluid perfectly tranſparent, and of very different denſity according to its compoſition. It is found for inſtance, that perfectly pure air of the temperature of our ordinary ſummer is conſiderably denſer than when it has diſſolved about half as much water as it can hold in that temperature; and that with this quantity of water the difference of denſity increaſes in proportion as the maſs grows warmer, for damp air is more expanſible by heat than dry air. We ſhall have occaſion to conſider this ſubject again, when we treat of the connection of the mechanical properties of air with the ſtate of the weather. See WEATHER.

19 This property of air denied by the Peripatetics, though acknowledged by their maſter.

Such is the reſult of the experiment ſuggeſted by Ariſtotle, evidently proving the weight of the air; and yet, as has been obſerved, the Peripatetics, who profeſs to follow the *dictates* of Ariſtotle, uniformly refuſed it this property. It was a matter long debated among the philoſophers of the laſt century. The reaſon was, that Ariſtotle, with that indiſtinctneſs and inconſiſtency which is obſerved in all his writings which relate to matters of fact and experience, aſſigns a different cauſe to many phenomena which any man led by common obſervation would aſcribe to the weight of the air. Of this kind is the riſe of water in pumps and ſyphons, which all the Peripatetics had for ages aſcribed to ſomething which they called *nature's abhorrence of a void.* Ariſtotle had aſſerted (for reaſons not our buſineſs to adduce at preſent), that all nature was full of being, and that nature abhorred a void. He adduces many facts, in which it appears, that if not abſolutely impoſſible, it is very difficult, and requires great force, to produce a ſpace void of matter. When the operation of pumps and ſyphons came to be known, the philoſophers of Europe (who had all embraced the Peripatetic doctrines) found in this fancied horror of a fancied mind (what elſe is this that nature abhors?) a ready ſolution of the phenomena. We ſhall ſtate the facts, that every reader may ſee what kinds of reaſoning were received among the learned not two centuries ago.

20 Conſtruction of pumps in the laſt century.

Pumps were then conſtructed in the following manner: A long pipe GB (fig. 4.) was ſet in the water of the well A. This was fitted with a ſucker or piſton C, having a long rod CF, and was furniſhed with a valve B at the bottom, and a lateral pipe DE at the place of delivery alſo furniſhed with a valve. The fact is, that if the piſton be thruſt down to the bottom, and then drawn up, the water will follow it; and upon the piſton being again puſhed down, the water ſhuts the valve B by its weight, and eſcapes or is expelled at the valve E; and on drawing up the piſton again the valve E is ſhut, the water again riſes after the piſton, and is again expelled at its next deſcent.

The Peripatetics explain all this by ſaying, that if the water did *not follow the piſton* there would be a void between

21
Their operation accounted for by the Peripatetics.

between them. But nature abhors a void; or a void is impoſſible: therefore the water follows the piſton.—It is not worth while to criticiſe the wretched reaſoning in this pretence to explanation. It is all overturned by one obſervation. Suppoſe the pipe ſhut at the bottom, the piſton *can* be drawn up, and thus a void produced. No, ſay the Peripatetics; and they ſpeak of certain ſpirits, effluvia, &c. which occupy the place. But if ſo, why needs the water riſe? This therefore is not the cauſe of its aſcent. It is a curious and important phenomenon.

22
Galileo firſt accounted for it rationally

The ſagacious Galileo ſeems to have been the firſt who ſeriouſly aſcribed this to the weight of the air. Many before him had ſuppoſed air heavy; and thus explained the difficulty of raiſing the board of bellows, or the piſton of a ſyringe, &c. But he diſtinctly applies to this allowed weight of the air all the conſequences of hydroſtatical laws; and he reaſons as follows.

23
By the weight of the atmoſphere,

The heavy air reſts on the water in the ciſtern, and preſſes it with its weight. It does the ſame with the water in the pipe, and therefore both are on a level: but if the piſton, after being in contact with the ſurface of the water, be drawn up, there is no longer any preſſure on the ſurface of the water within the pipe; for the air now reſts on the piſton only, and thus occaſions a difficulty in drawing it up. The water in the pipe, therefore, is in the ſame ſituation as if more water were poured into the ciſtern, that is, as much as would exert the ſame preſſure on its ſurface as the air does. In this caſe we are certain that the water will be preſſed into the pipe, and will raiſe up the water already in it, and follow it till it is equally high within and without. The ſame preſſure of the air ſhuts the valve E during the deſcent of the piſton. (See *Gal. Diſcourſes.*)

24
And predicted the height to which water would riſe in them.

He did not wait for the very obvious objection, that if the riſe of the water was the effect of the air's preſſure, it would alſo be its meaſure, and would be raiſed and ſupported only to a certain height. He directly ſaid ſo, and adduced this as a deciſive experiment. If the horror of a void be the cauſe, ſays he, the water muſt riſe to any height however great; but if it be owing to the preſſure of the air, it will only riſe till the weight of the water in the pipe is in equilibrio with the preſſure of the air, according to the common laws of hydroſtatics. And he adds, that this is well known; for it is a fact, that pumps will not *draw* water much above forty palms, although they may be made to *propel* it, or to *liſt it* to any height. He then makes an aſſertion, which, if true, will be deciſive. Let a very long pipe, ſhut at one end, be filled with water, and let it be erected perpendicularly with the cloſe end uppermoſt, and a ſtopper in the other end, and then its lower orifice immerſed into a veſſel of water; the water will ſubſide in the pipe upon removing the ſtopper, till the remaining column is in equilibrio with the preſſure of the external air. This experiment he propoſes to the curious; ſaying, however, that he thought it unneceſſary, there being already ſuch abundant proofs of the air's preſſure.

25
His prediction verified by Toricelli's experiment,

It is probable that the cumberſomeneſs of the neceſſary apparatus protracted the making of this experiment. Another equally concluſive, and much eaſier, was made in 1642 after Galileo's death, by his zealous and learned diſciple Toricelli. He filled a glaſs tube, cloſe at one end, with mercury; judging, that if the ſupport of the water was owing to the preſſure of the air, and was the meaſure of this preſſure, mercury would in like manner be ſupported by it, and this at a height which was alſo the meaſure of the air's preſſure, and therefore 13 times leſs than water. He had the pleaſure of ſeeing his expectation verified in the completeſt manner; the mercury deſcending in the tube AB (fig. 5.), and finally ſettling at the height *f*B of $29\frac{3}{4}$ Roman inches: and he found, that when the tube was inclined, the point *f* was in the ſame horizontal plane with *f* in the upright tube, according to the received laws of hydroſtatical preſſure. The experiment was often repeated, and ſoon became famous, exciting great controverſies among the philoſophers about the poſſibility of a vacuum. About three years afterwards the ſame experiment was publiſhed, at Warſaw in Poland, by Valerianus Magnus as his own ſuggeſtion and diſcovery: but it appears plain from the letters of Roberval, not only that Toricelli was prior, and that his experiment was the general topic of diſcuſſion among the curious; but alſo highly probable that Valerianus Magnus was informed of it when at Rome, and daily converſant with thoſe who had ſeen it. He denies, however, even having heard of the name of Toricelli.

Plate CCCXCIX.

26
Origin of the Royal Society, &c.

27
Invention of the air-pump.

This was the era of philoſophical ardour; and we think that it was Galileo's invention and immediate application of the teleſcope which gave it vigour. Diſcoveries of the moſt wonderful kind in the heavens, and which required no extent of previous knowledge to underſtand them, were thus put into the hands of every perſon who could purchaſe a ſpy-glaſs; while the high degree of credibility which ſome of the diſcoveries, ſuch as the phaſes of Venus and the rotation and ſatellites of Jupiter, gave to the Copernican ſyſtem, immediately ſet the whole body of the learned in motion. Galileo joined to his ardour a great extent of learning, particularly of mathematical knowledge and ſound logic, and was even the firſt who formally united mathematics with phyſics; and his treatiſe on accelerated motion was the firſt, and a precious fruit of this union. About the years 1642 and 1644, we find clubs of gentleman aſſociated in Oxford and London for the cultivation of knowledge by experiment; and before 1655 all the doctrines of hydroſtatics and pneumatics were familiar there, eſtabliſhed upon experiment. Mr Boyle procured a coalition and correſpondence of theſe clubs under the name of the Inviſible and Philoſophical Society. In May 1658 Mr Hooke finiſhed for Mr Boyle an air-pump, which had employed him a long time, and occaſioned him ſeveral journeys to London for things which the workmen of Oxford could not execute. He ſpeaks of this as a great improvement on Mr Boyle's own pump, which he had been uſing ſome time before. Boyle therefore muſt have invented his air-pump, and was not indebted for it to Schottus's account of Otto Guerick's, publiſhed in his (Schottus) *Mechanica Hydraulo-pneumatica* in 1657, as he aſſerts (*Techna Curioſa*). The Royal Society of London aroſe in 1656 from the coalition of theſe clubs, after 15 years co-operation and correſpondence. The Montmorine Society at Paris had ſubſiſted nearly about the ſame time; for we find Paſchal in 1648 ſpeaking of the meetings in the Sorbonne College, from which we know that ſociety originated.—Nuremberg, in Germany, was alſo a diſtinguiſhed ſeminary of experimental philoſophy. The magiſtrates, ſenſible of its valuable influence in manufactures, the ſource of the opulence and proſperity of their city, and many of them philoſophers, gave philoſophy a profeſſed and munificent patronage, furniſhing the philoſophers with a copious apparatus, a place of aſſembly, and a fund for the expence of their experiments; ſo that this was the firſt academy of ſciences out of Italy under the patronage of government. In Italy, indeed, there had long exiſted inſtitutions of this kind. Rome was centre of the church-government and the reſort of all expectants for preferment. The clergy were the majority of the learned in all Chriſtian nations, and particularly of the ſyſtematic philoſophers. Each, eager to recommend himſelf to notice, brought forward every thing that was curious; and they were the willing vehicles of philoſophical communications. Thus the experiments of Galileo and Toricelli were rapidly diffuſed by perſons of rank, the dignitaries of the church, or by the monks their obſequious ſervants. Perhaps the recent defection of England, and the want of a reſiding embaſſy at Rome, made her ſometimes late in receiving or ſpreading philoſophical reſearches, and was the cauſe that more was done there *proprio Marte*.

28
The experiments of Galileo and Toricelli rapidly diffuſed.

We hope to be excuſed for this digreſſion. We were naturally led into it by the pretenſions of Valerianus Magnus to originality in the experiment of the mercury ſupported by the preſſure of the air. Such is the ſtrength of national attachment, that there were not wanting ſome who found that Toricelli had borrowed his experiment from Honoratus Fabri, who had propoſed and explained it in 1641; but whoever knows the writings of Toricelli, and Galileo's high opinion of him, will never think that he could need ſuch helps. (See the ſurmiſe of Mounier in *Schott. Tech. Cur.* III. at the end.)

29
The merit of Toricelli's claimed by others

Galileo muſt be conſidered as the author of the experiment when he propoſes it to be made. Valerianus Magnus owns himſelf indebted to him for the principle and the contrivance of the experiment. It is neither wonderful that many ingenious men, of one opinion, and inſtructed by Galileo, ſhould ſeparately hit on ſo obvious a thing; nor that Toricelli, his immediate diſciple, his enthuſiaſtic admirer, and who was in the habits of correſponding with him till his death in 1642, ſhould be the firſt to put it in practice. It became the ſubject of diſpute from the national arrogance and ſelf-conceit of ſome Frenchmen, who have alway ſhown themſelves diſpoſed to conſider their nation as at the head of the republic of letters, and cannot brook the concurrence of any foreigners. Roberval was in this inſtance, however the champion of Toricelli; but thoſe who know his controverſies with the mathematicians of France at this time will eaſily account for this exception.

30
Unjuſtly.

All now agree in giving Toricelli the honour of the *firſt* invention; and it univerſally paſſes by the name of the TORICELLIAN EXPERIMENT. The tube is called the TORICELLIAN TUBE; and the ſpace left by the mercury is called the TORICELLIAN VACUUM, to diſtinguiſh it from the BOYLEAN VACUUM, which is only an extreme rarefaction.

31
It was repeated in various forms.

The experiment was repeated in various forms, and with apparatus which enabled philoſophers to examine ſeveral effects which the vacuum produced on bodies expoſed in it. This was done by making the upper part of the tube terminate in a veſſel of ſome capacity, or communicate with ſuch a veſſel, in which were included along with the mercury bodies on which the experiments were to be made. When the mercury had run out, the phenomena of theſe bodies were carefully obſerved.

32
An objection to the concluſion drawn from it obviated.

An objection was made to the concluſion drawn from Toricelli's experiment, which appears formidable. If the Toricellian tube be ſuſpended on the arm of a balance, it is found that the counterpoiſe muſt be equal to the weight both of the tube and of the mercury it contains. This could not be, ſay the objectors, if the mercury were ſupported by the air. It is evidently ſupported by the balance; and this gave riſe to another notion of the cauſe different from the peripatetic *fuga vacui*: a ſuſpenſive force, or rather attraction, was aſſigned to the upper part of the tube.

But the true explanation of the phenomenon is moſt eaſy and ſatisfactory, Suppoſe the mercury in the ciſtern and tube to freeze, but without adhering to the tube, ſo that the tube could be freely drawn up and down. In this caſe the mercury is ſupported by the baſe, without any dependence on the preſſure of the air; and the tube is in the ſame condition as before, and the ſolid mercury performs the office of a piſton to this kind of ſyringe. Suppoſe the tube thruſt down till the top of it touches the top of the mercury. It is evident that it muſt be drawn up in oppoſition to the preſſure of the external air, and it is preciſely ſimilar to the ſyringe mentioned in nº 16. The weight ſuſtained therefore by this arm of the balance is the weight of the tube and the downward preſſure of the atmoſphere on its top.

33
Galileo's original experiment performed.

The curioſity of philoſophers being thus excited by this very manageable experiment, it was natural now to try the original experiment propoſed by Galileo. Accordingly Berti in Italy, Paſchal in France, and many others in different places, made the experiment with a tube filled with water, wine, oil, &c. and all with the ſucceſs which might be expected in ſo ſimple a matter: and the doctrine of the weight and preſſure of the air was eſtabliſhed beyond contradiction or doubt. All was done before the year 1648.—A very beautiful experiment was exhibited by Auzout, which completely ſatiſfied all who had any remaining doubts.

34
An experiment by Auzout.
Plate cccxcix.

A ſmall box or phial EFGH (fig. 6.) had two glaſs tubes, AB, CD, three feet long, inſerted into it in ſuch a manner as to be firmly fixed in one end, and to reach nearly to the other end. AB was open at both ends, and CD was cloſe at D. This apparatus was completely filled with mercury, by unſcrewing the tube AB, filling the box, and the hole CD; then ſcrewing in the tube AB, and filling it: then holding a finger on the orifice A, the whole was inverted and ſet upright in the poſition repreſented in figure β, immerſing the orifice A (now *a*) in a ſmall veſſel of quickſilver. The reſult was, that the mercury ran out at the orifice *a*, till its ſurface *m n* within the phial deſcended to the top of the tube *ba*. The mercury alſo began to deſcend in the tube *dc* (formerly DC) and run over into the tube *ba*, and ran out at *a*, till the mercury in *dc* was very near equal in a level with *mn*. The mercury deſcending in *ba* till it ſtood at *k*, 29½ inches above the ſurface *op* of the mercury in the ciſtern, juſt as in the Toricellian tube.

The rationale of this experiment is very eaſy. The whole apparatus may firſt be conſidered as a Toricellian tube of an uncommon ſhape, and the mercury would flow out at *a*. But as ſoon as a drop of mercury comes out, leaving a ſpace above *m n*, there is nothing to keep up the mercury in the tube *dc*. Its mercury therefore deſcends alſo; and running over into *b a*, continues to ſupply its expence till the tube *dc* is almoſt empty, or can no longer ſupply the waſte of *b a*. The inner ſurface therefore falls as low as it can, till it is level with *b*. No more mercury can enter *b a*, yet its column is too heavy to be ſupported by the preſſure of the air on the mercury in the ciſtern below; it therefore deſcends in *b a*, and finally ſettles at the height *k o*, equal to that of the mercury in the Toricellian tube.

35 Deciſive of the queſtion.

The prettieſt circumſtance of the experiment remains. Make a ſmall hole *g* in the upper cap of the box. The external air immediately ruſhes in by its weight, and now preſſes on the mercury in the box. This immediately raiſes the mercury in the tube *d c* to *l*, 29$\frac{1}{2}$ inches above *m n*. It preſſes on the mercury at *k* in the tube *b a*, balancing the preſſure of the air in the ciſtern. The mercury in the tube therefore is left to the influence of its own weight, and it deſcends to the bottom. Nothing can be more appoſite or deciſive.

36 The gravity of the air therefore a ſtatical principle from which we obtain

And thus the doctrine of the gravity and preſſure of the air is eſtabliſhed by the moſt unexceptionable evidence: and we are intitled to aſſume it as a ſtatical principle, and to affirm *à priori* all its legitimate conſequences.

37 An exact meaſure of the preſſure of the atmoſphere

And in the firſt place, we obtain an exact meaſure of the preſſure of the atmoſphere. It is preciſely equal to the weight of the column of mercury, of water, of oil, &c. which it can ſupport; and the Toricellian tube, or others fitted up upon the ſame principle, are juſtly termed *baroſcopes* and *barometers* with reſpect to the air. Now it is obſerved that water is ſupported at the height of 32 feet nearly: The weight of the column is exactly 2000 avoirdupois pounds on every ſquare foot of baſe, or 13$\frac{9}{10}$ on every ſquare inch. The ſame concluſion very nearly may be drawn from the column of mercury, which is nearly 29$\frac{1}{2}$ inches high when in equilibrium with the preſſure of the air. We may here obſerve, that the meaſure taken from the height of a column of water, wine, ſpirits, and the other fluids of conſiderable volatility, as chemiſts term it, is not ſo exact as that taken from mercury, oil, and the like. For it is obſerved, that the volatile fluids are converted by the ordinary heat of our climates into vapour when the confining preſſure of the air is removed; and this vapour, by its elaſticity, exerts a ſmall preſſure on the ſurface of the water &c. in the pipe, and thus counteracts a ſmall part of the external preſſure; and therefore the column ſupported by the remaining preſſure muſt be lighter, that is, ſhorter. Thus it is found, that rectified ſpirits will not ſtand much higher than is competent to a weight of 13 pounds on an inch, the elaſticity of its vapour balancing about $\frac{1}{15}$ of the preſſure of the air. We ſhall afterwards have occaſion to conſider this matter more particularly.

As the medium height of the mercury in the barometer is 29$\frac{1}{2}$ inches, we ſee that the whole globe ſuſtains a preſſure equal to the whole weight of a body of mercury of this height; and that all bodies on its ſurface ſuſtain a part of this in proportion to their ſubſtances.

38 A difficulty ſolved.

An ordinary ſized man ſuſtains a preſſure of ſeveral thouſand pounds. How comes it then that we are not ſenſible of a preſſure which one ſhould think enough to cruſh us together? This has been conſidered as a ſtrong objection to the preſſure of the air for when a man is plunged a few feet under water, he is very ſenſible of the preſſure. The anſwer is by no means ſo eaſy as is commonly imagined. We feel very diſtinctly the effects of removing this preſſure from any part of the body. If any one will apply the open end of a ſyringe to his hand, and then draw up the piſton, he will find his hand ſucked into the ſyringe with great force, and it will give pain; and the ſoft part of the hand will ſwell into it, being preſſed in by the neighbouring parts, which are ſubject to the action of the external air. If one lays his hand on the top of a long perpendicular pipe, ſuch as a pump filled to the brim with water, which is at firſt prevented from running out by the valve below; and if the valve be then opened, ſo that the water deſcends, he will then find his hand ſo hard preſſed to the top of the pipe that he cannot draw it away. But why do we only feel the *inequality* of preſſure? There is a ſimilar inſtance wherein we do not feel it, although we cannot doubt of its exiſtence. When a man goes ſlowly to a great depth under water in a diving-bell, we know unqueſtionably that he is expoſed to a new and very great preſſure, yet he does not feel it. But thoſe facts are not ſufficiently familiar for general argument. The human body is a bundle of ſolids, hard or ſoft, filled or mixed with fluids, and there are few or no parts of it which are empty. All communicate either by veſſels or pores; and the whole ſurface is a ſieve through which the inſenſible perſpiration is performed. The whole extended ſurface of the lungs is open to the preſſure of the atmoſphere; every thing is therefore in equilibrio: and if free or ſpeedy acceſs be given to every part, the body will not be damaged by the preſſure, however great, any more than a wet ſponge would be deranged by plunging it any depth in water. The preſſure is inſtantaneouſly diffuſed by means of the incompreſſible fluids with which the parts are filled; and if any parts are filled with air or other compreſſible fluids, theſe are compreſſed till their elaſticity again balances the preſſure. Beſides, all our fluids are acquired ſlowly, and gradually mixed with that proportion of air which they can diſſolve or contain. The whole animal has grown up in this manner from the firſt vital atom of the embryo. For ſuch reaſons the preſſure can occaſion no change of ſhape by ſqueezing together the flexible parts; nor any obſtruction by compreſſing the veſſels or pores. We cannot ſay what would be felt by a man, were it poſſible that he could have been produced and grown up *in vacuo*, and then ſubjected to the compreſſion. We even know that any ſudden and conſiderable change of general preſſure is very ſeverely felt. Perſons in a diving-bell have been almoſt killed by letting them down or drawing them up too ſuddenly. In drawing up, the elaſtic matters within have ſuddenly ſwelled, and not finding an immediate eſcape have burſt the veſſels. Dr Halley experienced this, the blood guſhing out from his ears by the expanſion of air contained in the internal cavities of this organ, from which there are but very ſlender paſſages.

Fig. 4.

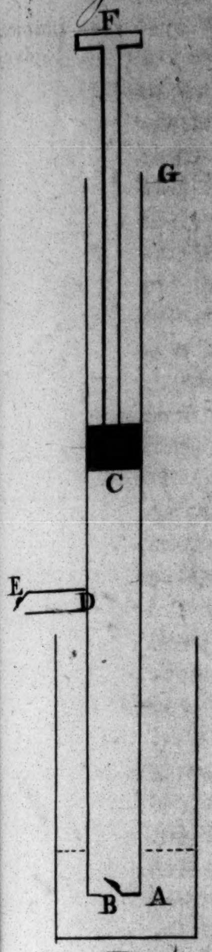


Fig. 3.

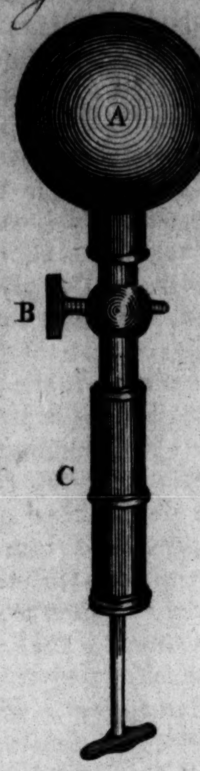
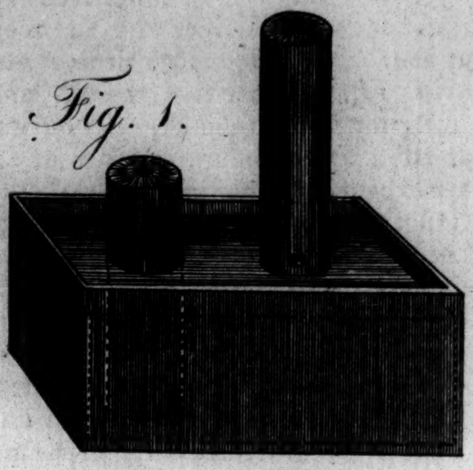


Fig. 1.



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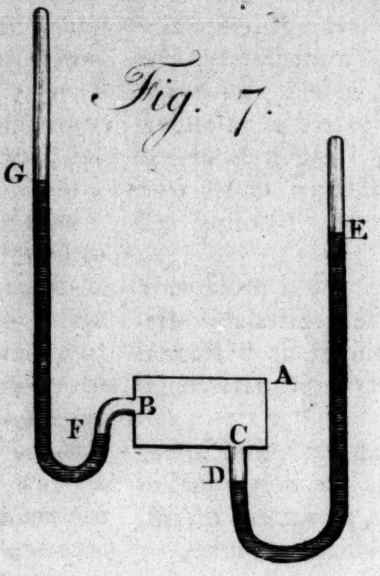

Fig. 2.

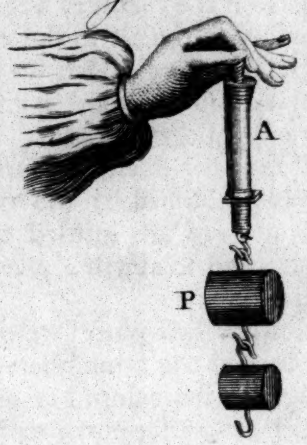

Fig. 6.

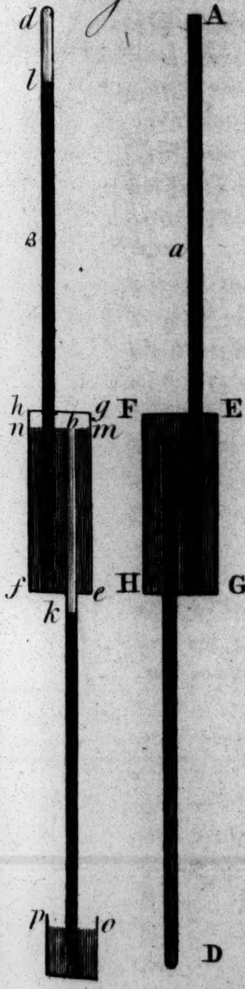
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Fig. 9.

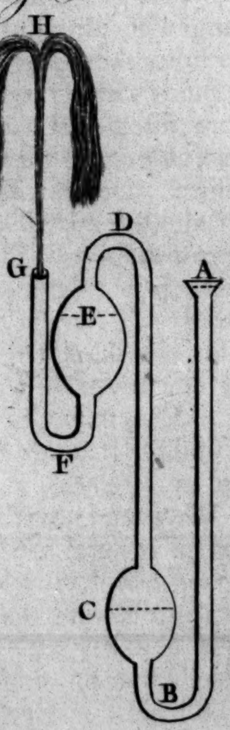

Fig. 8.

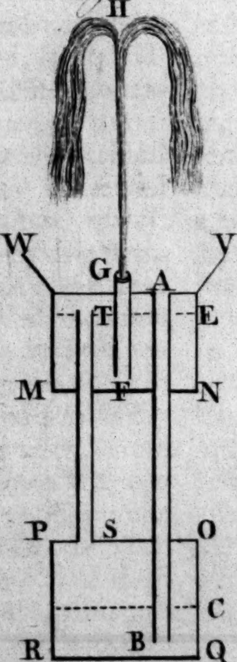
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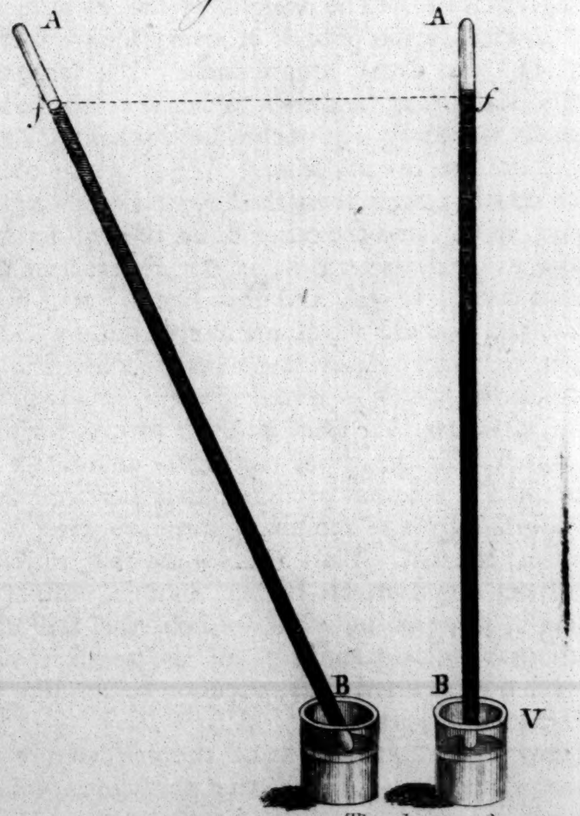
Fig. 5.



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39 The weather-glaſs.

A very important obſervation recurs here: the preſſure of the atmoſphere is variable. This was obſerved almoſt as ſoon as philoſophers began to attend to the barometer. Paſchal obſerved it in France, and Deſcartes obſerved it in Sweden in 1650. Mr Boyle and others obſerved it in England in 1656. And before this, obſervers, who took notice of the concomitancy of theſe changes of aerial preſſure with the ſtate of the atmoſphere, remarked, that it was generally greateſt in winter and in the night; and certainly moſt variable during winter and in the northern regions. Familiar now with the weight of the air, and conſidering it as the vehicle of the clouds and vapours, they noted with care the connection between the weather and the preſſure of the air, and found that a great preſſure of the air was generally accompained with fair weather, and a diminution of it with rain and miſts. Hence the barometer came to be conſidered as an index not only of the preſent ſtate of the air's weight, but alſo as indicating by its variations changes of weather. It became a WEATHER-GLASS, and continued to be anxiouſly obſerved with this view. This is an important ſubject, and will afterwards be treated in ſome detail.

40 The preſſure of the air in proportion to the elevation.

In the next place, we may conclude that the preſſure of the air will be different in different places, according to their elevation above the ſurface of the ocean: for if air be an heavy fluid, it muſt preſs in ſome proportion according to its perpendicular height. If it be a homogeneous fluid of equal denſity and weight in all its parts, the mercury in the ciſtern of a barometer muſt be preſſed preciſely in proportion to the depth to which that ciſtern is immerſed in it; and as this preſſure is exactly meaſured by the height of the mercury in the tube, the height of the mercury in the Toricellian tube muſt be exactly proportional to the depth of the place of obſervation under the ſurface of the atmoſphere.

41 Firſt ſuppoſed by Deſcartes and Paſchal and proved by experiments.

The celebrated Deſcartes firſt entertained this thought (Epiſt. 67. of Pr. III.), and ſoon after him Paſchal. His occupation in Paris not permitting him to try the juſtneſs of his conjecture, he requeſted Mr Perrier, a gentleman of Clermont in Auvergne, to make the experiment, by obſerving the height of the mercury at one and the ſame time at Clermont and on the top of a very high mountain in the neighbourhood. His letters to Mr Perrier in 1647 are ſtill extant. Accordingly Mr Perrier, in September 1648, filled two equal tubes with mercury, and obſerved the heights of both to be the ſame, viz. $26\frac{7}{24}$ inches, in the garden of the convent of the Friars Minims, ſituated in the loweſt part of Clermont. Leaving one of them there, and one of the fathers to obſerve it, he took the other to the top of Puy de Domme, which was elevated nearly 500 French fathoms above the garden. He found its height to be $23\frac{2}{24}$ inches. On his return to the town, in a place called *Font de l'Arbre*, 150 fathoms above the garden, he found it 25 inches; when he returned to the garden it was again $26\frac{7}{24}$, and the perſon ſet to watch the tube which had been left ſaid that it had not varied the whole day. Thus a difference of elevation of 3000 French feet had occaſioned a depreſſion of $3\frac{1}{8}$ inches; from which it may be concluded, that $3\frac{1}{8}$ inches of mercury weighs as much as 3000 feet of air, and one-tenth of an inch of mercury as much as 96 feet of air. The next day he found, that taking the tube to the top of a ſteeple 120 feet high made a fall of one-ſixth of an inch. This gives 72 feet of air for one-tenth of an inch of mercury; but ill agreeing with the former experiment. But it is to be obſerved, that a very ſmall error of obſervation of the barometer would correſpond to a great difference of elevation, and alſo that the height of the mountain had not been meaſured with any preciſion. This has been ſince done (Mem. Acad. par. 1703), and found to be 529 French toiſes.

42 Which were repeated by others.

Paſchal publiſhed an account of this great experiment (*Grande Exp. ſur la Peſanteur de l'Air*). and it was quickly repeated in many places of the world. In 1653 it was repeated in England by Dr Power (Power's Exper. Phil.); and in Scotland, in 1661, by Mr Sinclair profeſſor of philoſophy in the univerſity of Glaſgow, who obſerved the barometer at Lanark, on the top of mount Tintock in Clydſdale, and on the top of Arthur's Seat at Edinburgh. He found a depreſſion of two inches between Glaſgow and the top of Tintock, three quarters of an inch between the bottom and top of Arthur's Seat, and $\frac{5}{32}$ of an inch at the cathedral of Glaſgow on a height of 126 feet. See Sinclair's *Ars Nova et Magna Gravitatis et Levitatis; Sturmii Collegium Experimentale*, and *Schotti Technica Curioſa.*

43 Hence a method of meaſuring heights.

Hence we may derive a method of meaſuring the heights of mountains. Having aſcertained with great preciſion the elevation correſponding to a fall of one-tenth of an inch of mercury, which is nearly 90 feet, we have only to obſerve the length of the mercurial column at the top and bottom of the mountain, and to allow 90 feet for every tenth of an inch. Accordingly this method has been practiſed with great ſucceſs: but it requires an attention to many things not yet conſidered; ſuch as the change of denſity of the mercury by heat and cold; the changes of denſity of air, which are much more remarkable from the ſame cauſes; and above all, the changes of the denſity of air from its compreſſibility; a change immediately connected with or dependent on the very elevation we wiſh to meaſure. Of all theſe afterwards.

44 Alſo a meaſure of the denſity of the air,

Theſe obſervations give us the moſt accurate meaſure of the denſity of the air and its ſpecific gravity. This is but vaguely though directly meaſured by weighing air in a bladder or veſſel. The weight of a manageable quantity is ſo ſmall, that a balance ſufficiently tickliſh to indicate even very ſenſible fractions of it is overloaded by the weight of the veſſel which contains it, and ceaſes to be exact: and when we take Bernoulli's ingenious method of ſuſpending it in water, we expoſe ourſelves to great riſk of error by the variation of the water's denſity. Alſo it muſt neceſſarily be humid air which we can examine in this way: but the proportion of an elevation in the atmoſphere to the depreſſion of the column of mercury or other fluid, by which we meaſure its preſſure, gives us at once the proportion of this weight or their ſpecific gravity. Thus ſince it is found that in ſuch a ſtate of preſſure that the barometer ſtands at 30 inches, and the thermometer at 32°, 87 feet of riſe produces one-tenth of an inch of fall in the barometer, the air and the mercury being both of the freezing temperature, we muſt conclude that mercury is 10,440 times heavier or denſer than air. Then, by comparing mercury and water, we get $\frac{1}{801}$ nearly for the denſity of air relative to water: but this varies ſo much by heat and moiſture, that it is uſeleſs to retain any thing more than a general notion of it; nor is it eaſy to determine whether this method or that by actual weighing is preferable. It is extremely difficult to obſerve the height of the mercury in the barometer nearer than $\frac{1}{100}$ of an inch; and this will produce a difference of even five feet, or $\frac{1}{20}$ of the whole. Perhaps this is a greater proportion than the error in weighing.

45 And ſome knowledge of the height of the atmoſphere.

From the ſame experiments we alſo derive ſome knowledge of the height of the aerial covering which ſurrounds our globe. When we raiſe our barometer 87 feet above the ſurface of the ſea, the mercury falls about one-tenth of an inch in the barometer: therefore if the barometer ſhows 30 inches at the ſea-ſhore, we may expect that, by raiſing it 300 times 87 feet or 5 miles, the mercury in the tube will deſcend to the level of the ciſtern, and that this is the height of our atmoſphere. But other appearances lead us to ſuppoſe a much greater height. Meteors are ſeen with us much higher than this, and which yet give undoubted indication of being ſupported by our air. There can be little doubt, too that the viſibility of the expanſe above us is owing to the reflection of the ſun's light by our air. Were the heavenly ſpaces perfectly tranſparent, we ſhould no more ſee them than the pureſt water through which we ſee other objects; and we ſee *them* as we ſee water tinged with milk or other ſæculæ. Now it is eaſy to ſhow, that the light which gives us what is called twilight muſt be reflected from the height of at leaſt 50 miles; for we have it when the ſun is depreſſed 18 degrees below our horizon.

46 Why this knowledge is not accurate.

A little attention to the conſtitution of our air will convince us, that the atmoſphere muſt extend to a much greater height than 300 times 87 feet. We ſee from the moſt familiar facts that it is compreſſible; we can ſqueeze it in an ox-bladder. It is alſo heavy; preſſing on the air in this bladder with a very great force, not leſs than 1500 pounds. We muſt therefore conſider it as in a ſtate of compreſſion, exiſting in ſmaller room than it would aſſume if it were not compreſſed by the incumbent air. It muſt therefore be in a condition ſomething reſembling that of a quantity of fine carded wool thrown looſely into a deep pit; the lower ſtrata carrying the weight of the upper ſtrata, and being compreſſed by them; and ſo much the more compreſſed as they are further down, and only the upper ſtratum in its unconſtrained and moſt expanded ſtate. If we ſhall ſuppoſe this wool thrown in by a hundred weight at a time, it will be divided into ſtrata of equal weights, but of unequal thickneſs; the loweſt being the thinneſt, and the ſuperior ſtrata gradually increaſing in thickneſs. Now, ſuppoſe the pit filled with air, and reaching to the top of the atmoſphere, the *weights* of all the ſtrata above any horizontal plane in it is meaſured by the height of the mercury in the Toricellian tube placed in that plane; and one-tenth of an inch of mercury is juſt equal to the weight of the loweſt ſtratum 87 feet thick: for on raiſing the tube 87 feet from the ſea, the ſurface of the mercury will deſcend one-tenth of an inch. Raiſe the tube till the mercury fall another tenth: This ſtratum muſt be more than 87 feet thick; how much more we cannot tell, being ignorant of the law of the air's expanſion. In order to make it fall a third tenth, we muſt raiſe it through a ſtratum ſtill thicker; and ſo on continually.

All this is abundantly confirmed by the very firſt experiment made by the order and directions of Paſchal; For by carrying the tube from the garden of the convent to a place 150 fathoms higher, the mercury fell $1\frac{7}{24}$ inches, or 1,2917; which gives about 69 feet 8 inches of aerial ſtratum for $\frac{1}{10}$ of an inch of mercury; and by carrying it from thence to a place 350 fathoms higher, the mercury fell $1\frac{11}{12}$, or 1,9167 inches, which gives 109 feet 7 inches for $\frac{1}{10}$ of an inch of mercury. Theſe experiments were not accurately made; for at that time the philoſophers, though zealous, were but *ſcholars* in the *ſcience* of experimenting, and *novices* in the art. But the reſults abundantly ſhow this general truth, and they are completely confirmed by thouſands of ſubſequent obſervations. It is evident from the whole tenor of them, that the ſtrata of air decreaſe in denſity as we aſcend through the atmoſphere; but it remained to be diſcovered what is the force of this decreaſe, that is, the law of the air's expanſion. Till this be done we can ſay nothing about the conſtitution of our atmoſphere: we cannot tell in what manner it is fitteſt for raiſing and ſupporting the exhalations and vapours which are continually ariſing from the inhabited regions; not as an excrementitious waſte, but to be ſupported, perhaps manufactured, in that vaſt laboratory of nature, and to be returned to us in beneficent ſhowers. We cannot uſe our knowledge for the curious, and frequently uſeful, purpoſe of meaſuring the heights of mountains and taking the levels of extenſive regions; in ſhort, without an accurate knowledge of this we can hardly acquire any acquaintance with thoſe mechanical properties which diſtinguiſh air from thoſe liquids which circulate here below.

47 Compreſſibility of the air.

Having therefore conſidered at ſome length the leading conſequences of the air's fluidity and gravity, let us conſider its compreſſibility with the ſame care; and then, combining the agency of both, we ſhall anſwer all the purpoſes of philoſophy, diſcover the laws, explain the phenomena of nature, and improve art. We proceed therefore to conſider a little the phenomena which indicate and characteriſe this other property of the air. All fluids are elaſtic and compreſſible as well as air; but in them the compreſſibility makes no figure, or does not intereſt us while we are conſidering their preſſures, motions, and impulſions. But in air the compreſſibility and expanſion draw our chief attention, and make it a proper repreſentative of this claſs of fluids.

48 A familiar phenomenon, which

Nothing is more familiar than the compreſſibility of air. It is ſeen in a bladder filled with it, which we can forcibly ſqueeze into leſs room; it is ſeen in a ſyringe, of which we can puſh the plug farther and farther as we increaſe the preſſure.

49 Shows its elaſticity,

But theſe appearances bring into view another, and the moſt intereſting, property of air, *viz.* its *elaſticity*. When we have ſqueezed the air in the bladder or ſyringe into leſs room, we find that the force with which we *compreſſed* it is neceſſary to *keep it in this bulk;* and that if we ceaſe to preſs it together, it will ſwell out and regain its natural dimenſions. This diſtinguiſhes it eſſentially from ſuch a body as a maſs of flour, ſalt, or ſuch like, which remain in the compreſſed ſtate to which we reduce them.

50 Reſiſting force, and producing motion.

There is therefore ſomething which oppoſes the compreſſion different from the ſimple impenetrability of the air: there is ſomething that oppoſes mechanical force: there is ſomething too which produces motion, not only reſiſting compreſſion, but puſhing back the compreſſing body, and communicating motion to it. As an arrow is gradually accelerated by the bow-ſtring preſſing it forward, and at the moment of its diſcharge is brought to a ſtate of rapid motion; ſo the ball from a pop-gun or wind-gun is gradually accelerated along the barrel by the preſſure of the air during its expanſion from its compreſſed ſtate, and finally quits it with an accumulated velocity. Theſe two motions are indications perfectly ſimilar of the elaſticity of the bow and of the air.

51 Fluidity of the air

Thus it appears that air is heavy and elaſtic. It needs little conſideration to convince us in a vague manner that it is fluid. The eaſe with which it is penetrated, and driven about in every direction, and the motion of it in pipes, and channels, however crooked and intricate, intitle it to this character. But before we can proceed to deduce conſequences from its fluidity, and to offer them as a true account of what will happen in theſe circumſtances, it is neceſſary to exhibit ſome diſtinct and ſimple caſe, in which the characteriſtic mechanical property of a fluid is clearly and unequivocally obſerved in it. That property of fluids from which all the laws of hydroſtatics and hydraulics are derived with ſtricteſt evidence is, that any preſſure applied to any part of them is propagated through the whole maſs in every direction: and that in conſequence of this diffuſion of preſſure, any two external forces can be put in equilibrio by the interpoſition of a fluid, in the ſame way as they can be put in equilibrio by the intervention of any mechanical engine.

52 Experimentally

Let a cloſe veſſel ABC (fig. 7.), of any form, have two upright pipes EDC, GFB, inſerted into any parts of its top, ſides, or bottom, and let water be poured into them, ſo as to ſtand in equilibrio with the horizontal ſurfaces at E, D, G, F, and let D*d*, F*f*, be horizontal lines, *it will be found* that the height of the column E*d* is ſenſibly equal to that of the column G*f*. This is a fact univerſally obſerved in whatever way the pipes are inſerted.

53 Proved,

Now the ſurface of the water at D is undoubtedly preſſed upwards with a force equal to a column of water, having its ſurface for its baſe, and E*d* for its height; it is therefore prevented from riſing by ſome oppoſite force. This can be nothing but the elaſticity of the confined air preſſing it down. The very ſame thing muſt be ſaid of the ſurface at F; and thus there are two external preſſures at D and F ſe in equlibrio by the interpoſition of air. The force exerted on the ſurface D, by the preſſure of the column E*d*, is therefore propagated to the ſurface at F; and thus air has this characteriſtic mark of fluidity.

In this experiment the *weight* of the air is inſenſible when the veſſel is of ſmall ſize, and has no ſenſible ſhare in the preſſure reaching at D and F. But if the elevation of the point F above D is very great, the column E*d* *will be obſerved* ſenſibly to exceed the column G*f*. Thus if F be 70 feet higher than D, E*d* will be an inch longer than the column G*f*: for in this caſe there is reacting at D, not only the preſſure propagated from F, but alſo the weight of a column of air, having the ſurface at D for its baſe and 70 feet high. This is equal to the weight of a column of water one inch high.

It is by this propagation of preſſure, this *fluidity*, that the pellet is diſcharged from a child's pop-gun. It ſticks faſt in the muzzle; and he forces in another pellet at the other end, which he preſſes forward with the rammer, condenſing the air between them, and thus propagating to the other pallet the preſſure which he exerts, till the friction is overcome, and the pellet is diſcharged by the air expanding and following it.

54 Hiero's fountain.

There is a pretty philoſophical plaything which illuſtrates this property of air in a very perſpicuous manner, and which we ſhall afterwards have occaſion to conſider as converted into a moſt uſeful hydraulic machine. This is what is uſually called *Hiero's fountain*, having been invented by a Syracuſan of that name. It conſiſts of two veſſels KLMN (fig. 8.), OPQR, which are cloſe on all ſides. A tube AB, having a funnel a-top, paſſes through the uppermoſt veſſel without communicating with it, being ſoldered into its top and bottom. It alſo paſſes through the top of the under-veſſel, where it is alſo ſoldered, and reaches almoſt to its bottom. This tube is open at both ends. There is another open tube ST, which is ſoldered into the top of the under-veſſel and the bottom of the upper veſſel, and reaches almoſt to its top. Theſe two tubes ſerve alſo to ſupport the upper veſſel. A third tube GF is ſoldered into the top of the upper veſſel, and reaches almoſt to its bottom. This tube is open at both ends, but the orifice G is very ſmall. Now ſuppoſe the uppermoſt veſſel filled with water to the height EN, E*e* being its ſurface a little below T. Stop the orifice G with the finger, and pour in water at A. This will deſcend through AB, and compreſs the air in OQRP into leſs room. Suppoſe the water in the under veſſel to have acquired the ſurface C*c*, the air which formerly occupied the whole of the ſpaces OPQR and KL*e*E will now be contained in the ſpaces *o*P*c* C and KL*e*E; and its elaſticity will be in equilibrio with the weight of the column of water, whoſe baſe is the ſurface E*e*, and whoſe height is A*c*. As this preſſure is exerted in every part of the air, it will be exerted on the ſurface E*e* of the water of the upper veſſel; and if the pipe FG were continued upwards, the water would be ſupported in it to an height *e*H above E*e*, equal to A*c*. Therefore if the finger be now taken from off the orifice G, the water will ſpout up to the ſame height as if it had been immediately forced out by a column of water A*c* without the intervention of the air, that is, nearly to H. If inſtead of the funnel at A, the veſſel have a brim which will cauſe the water diſcharged at G to run down the pipe AB, this fountain will play till all the water in the upper veſſel is expended. The operation of this ſecond fountain will be better underſtood from fig. 9. which an intelligent render will ſee is perfectly equivalent to fig. 8. A very powerful engine for raiſing water upon this principle has long been employed in the Hungarian mines; where the pipe AB is about 200 feet high, and the pipe FG about 120; and the condenſation is made in the upper veſſel, and communicated to the lower, at the bottom of the mine, by a long pipe. See *Water-Works*.

55 Laws of hydroſtatics applicable to air.

We may now apply to air all the laws of hydroſtatics and hydraulics, in perfect confidence that their legitimate conſequences will be obſerved in all its ſituations. We ſhall in future ſubſtitute, in place of any force acting on a ſurface of air, a column of water, mercury, or any other fluid whoſe weight is equal to this force: and as we know diſtinctly from theory what will be the conſequences of this hydroſtatic preſſure, we ſhall determine *à priori* the phenomena in air; and in caſes where theory does not enable us to ſay with preciſion what is the effect of this preſſure, experience informs us in the caſe of water, and analogy enables us to transfer this to air. We ſhall find this of great ſervice in ſome caſes, which otherwiſe are almoſt deſperate in the preſent ſtate of our knowledge.

56 More refined experiments, ſuch as

From ſuch familiar and ſimple obſervations and experiments, the fluidity, the heavineſs, and elaſticity, are diſcovered of the ſubſtance with which we are ſurrounded, and which we call *air*. But to underſtand theſe properties, and completely to explain their numerous and important conſequences, we muſt call in the aid of more refined obſervations and experiments which even this ſcanty knowledge of them enables us to make; we muſt contrive ſome methods of producing with preciſion any degree of condenſation or rarefaction, of employing or excluding the gravitating preſſure of air, and of modifying at pleaſure the action of all its mechanical properties.

57 A method of compreſſing the air by

Nothing can be more obvious than a method of compreſſing a quantity of air to any degree. Take a cylinder or priſmatic tube AB (fig. 10.) ſhut at one end, and fit it with a piſton or plug C, ſo nicely that no air can paſs by its ſides. This will be beſt done in a cylindric tube by a turned ſtopper, covered with oiled leather, and fitted with a large handle CD. When this is thruſt down, the air which formerly occupied the whole capacity of the tube is *condenſed* into leſs room. The force neceſſary to produce any degree of compreſſion may be concluded from the weight neceſſary for puſhing down the plug to any depth. But this inſtrument leaves us little opportunity of making intereſting experiments on or in this condenſed air; and the force required to make any degree of compreſſion cannot be meaſured with much accuracy; becauſe the piſton muſt be very cloſe, and have great friction, in order to be ſufficiently tight: And as the compreſſion is increaſed, the leather is more ſqueezed to the ſide of the tube; and the proportion of the external force, which is employed merely to overcome this variable and uncertain friction, cannot be aſcertained with any tolerable preciſion. To get rid of theſe imperfections, the following addition may be made to the inſtrument, which then becomes what is called the *condenſing ſyringe*.

58 The condenſing ſyringe with

The end of the ſyringe is perforated with a very ſmall hole *ef*; and being externally turned to a ſmall cylinder, a narrow ſlip of bladder, or of thin leather, ſoaked in a mixture of oil and tallow, muſt be tied over the hole. Now let us ſuppoſe the piſton puſhed down to the bottom of the barrel to which it applies cloſe; when it is drawn up to the top, it leaves a void behind, and the weight of the external air preſſes on the ſlip of bladder, which therefore claps cloſe to the braſs, and thus performs the part of a valve, and keeps it cloſe ſo that no air can enter. But the piſton having reached the top of the barrel, a hole F in the ſide of it is juſt below the piſton, and the air ruſhes through this hole and fills the barrel. Now puſh the piſton down again, it immediately paſſes the hole F, and no air eſcapes through it; it therefore forces open the valve at *f*, and eſcapes while the piſton moves to the bottom.

59 Its veſſel or receiver.

Now let E be any veſſel, ſuch as a glaſs bottle, having its mouth furniſhed with a braſs cap firmly cemented to it, having a hollow ſcrew which fits a ſolid ſcrew *p o*, turned on the cylindric nozzle of the ſyringe. Screw the ſyringe into this cap, and it is evident that the air forced out of the ſyringe will be accumulated in this veſſel: for upon drawing up the piſton the valve *f* always ſhuts by the elaſticity or expanding force of the air in E; and on puſhing it down again, the valve will open as ſoon as the piſton has got ſo far down that the air in the lower part of the barrel is more powerful than the air already in the veſſel. Thus at every ſtroke an additional barrelful of air will be forced into the veſſel E; and it will be found, that after every ſtroke the piſton muſt be farther puſhed down before the valve will open. It cannot open till the preſſure ariſing from the elaſticity of the air condenſed in the barrel is ſuperior to the elaſticity of the air condenſed in the veſſel; that is, till the condenſation of the firſt, or its denſity, is *ſomewhat* greater than that of the laſt, in order to overcome the ſtraining of the valve on the hole and the ſticking occaſioned by the clammy matter employed to make it air-tight.

60 A different conſtruction of this ſyringe,

Sometimes the ſyringe is conſtructed with a valve in the piſton. This piſton, inſtead of being of one piece and ſolid, conſiſts of two pieces perforated. The upper part *i k n m* is connected with the rod or handle, and has its lower part turned down to a ſmall cylinder, which is ſcrewed into the lower part *k l o n*; and has a perforation *g h* going up in the axis, and terminating in a hole *h* in one ſide of the rod, a piece of oiled leather is ſtrained acroſs the hole *g*. When the piſton is drawn up and a void left below it, the weight of the external air forces it through the hole *h g*, opens the valve *g*, and fills the barrel. Then, on puſhing down the piſton, the air being ſqueezed into leſs room, preſſes on the valve *g*, ſhuts it; and none eſcaping through the piſton, it is gradually condenſed as the piſton deſcends till it opens the valve *f*, and is added to that already accumulated in the veſſel E.

61 Elaſticity of the air increaſed by condenſation.

Having in this manner forced a quantity of air into the veſſel E, we can make many experiments in it in this ſtate of condenſation. We are chiefly concerned at preſent with the effect which this produces on its elaſticity. We ſee this to be greatly increaſed; for we find more and more force required for introducing every ſucceſſive barrelful. When the ſyringe is unſcrewed, we ſee the air ruſh out with great violence, and every indication of great expanding force. If the ſyringe be connected with the veſſel E in the ſame manner as the ſyringe in nº 17, viz. by interpoſing a ſtopcock B between them (ſee fig. 3), and if this ſtopcock have a pipe at its extremity, reaching near to the bottom of the veſſel, which is previouſly half filled with water, we can obſerve diſtinctly when the elaſticity of the air in the ſyringe exceeds that of the air in the receiver: for the piſton muſt be puſhed down a certain length before the air from the ſyringe bubbles up thro' the water, and the piſton muſt be farther down at each ſucceſſive ſtroke before this appearance is obſerved. When the air has thus been accumulated in the receiver, it preſſes the ſides of it outward, and will burſt it if not ſtrong enough. It alſo preſſes on the ſurface of the water; and if we now ſhut the cock, unſcrew the ſyringe, and open the cock again, the air will force the water through the pipe with great velocity, cauſing it to riſe in a beautiful jet. When a metal-receiver is uſed, the condenſation may be puſhed to a great length, and the jet will then riſe to a great height; which gradually diminiſhes as the water is expended and room given to the air to expand itſelf. See the figure.

62 A method of judging of the condenſation, &c.

We judge of the condenſation of air in the veſſel E by the number of ſtrokes and the proportion of the capacity of the ſyringe to that of the veſſel. Suppoſe the firſt to be one-tenth of the laſt; then we know, that after 10 ſtrokes the quantity of air in the veſſel is doubled, and therefore its denſity double, and ſo on after any number of ſtrokes. Let the capacity of the ſyringe (when the piſton is drawn to the top) be a, and that of the veſſel be b, and the number of ſtrokes be n, the denſity of air in the veſſel will be $\frac{b+na}{b}$, or $1+\frac{na}{b}$.

63 Not perfectly accurate.

But this is on the ſuppoſition that the piſton accurately fills the barrel, the bottom of the one applying cloſe to that of the other, and that no force is neceſſary for opening either of the valves: but the firſt cannot be inſured, and the laſt is very far from being true. In the conſtruction now deſcribed, it will require at leaſt one twentieth-part of the ordinary preſſure of the air to open the piſton valve: therefore the air which gets in will want at leaſt this proportion of its complete elaſticity; and there is always a ſimilar part of the elaſticity employed in opening the nozzle valve. The condenſation therefore is never nearly equal to what is here determined.

64 A better method.

It is accurately enough meaſured by a gage fitted to the inſtrument. A glaſs tube GH of a cylindric bore, and cloſe at the end, is ſcrewed into the ſide of the cap on the mouth of the veſſel E. A ſmall drop of water or mercury is taken into this tube by warming it a little in the hand, which expands the contained air, ſo that when the open end is dipped into water, and the whole allowed to cool, the water advances a little into the tube. The tube is furniſhed with a ſcale divided into ſmall equal parts, numbered from the cloſe end of the tube. Since this tube communicates with the veſſel, it is evident that the condenſation will force the water along the tube, acting like a piſton on the air beyond it, and the air in the tube and veſſel will always be of one denſity. Suppoſe the number at which the drop ſtands before the condenſation is made to be c, and that it ſtands at d when the condenſation has attained the degree required, the denſity of the air in the remote end of the gage, and conſequently in the veſſel, will be $\frac{c}{d}$.

65 A variation of it.

Sometimes there is uſed any bit of tube cloſe at one end, having a drop of water in it, ſimply laid into the veſſel E, and furniſhed or not with a ſcale: but this can only be uſed with glaſs veſſels, and theſe are too weak to reſiſt the preſſure ariſing from great condenſation. In ſuch experiments metalline veſſels are uſed, fitted with a variety of apparatus for different experiments. Some of theſe will be occaſionally mentioned afterwards.

66 Syringes for great condenſations.

It muſt be obſerved in this place, that very great condenſations require great force, and therefore ſmall ſyringes. It is therefore convenient to have them of various ſizes, and to begin with thoſe of a larger diameter, which operate more quickly; and when the condenſation becomes fatiguing, to change the ſyringe for a ſmaller.

67 A ſtop-cock between the ſyringe and receiver.

For this reaſon, and in general to make the condenſing apparatus more convenient, it is proper to have a ſtop-cock interpoſed between the ſyringe and the veſſel, or as it is uſually called the receiver. This conſiſts of a braſs pipe, which has a well-ground cock in its middle, and has a hollow ſcrew at one end, which receives the nozzle ſcrew of the ſyringe, and a ſolid ſcrew at the other end, which fits the ſcrew of the receiver. See fig. 3.

68 Inſtances of great condenſation prove

By theſe gages, or contrivances ſimilar to them, we have been able to aſcertain very great degrees of condenſation in the courſe of ſome experiments. Dr Hales found, that when dry wood was put into a ſtrong veſſel, which it almoſt filled, and the remainder was filled with water, the ſwelling of the wood, occaſioned by its imbibition of water, condenſed the air of his gage into the thouſandth of its original bulk. He found that peaſe treated in the ſame way generated elaſtic air, which preſſing on the air in the gage condenſed it into the fifteen hundredth part of its bulk. This is the greateſt condenſation that has been aſcertained with preciſion, although in other experiments it has certainly been carried much farther; but the preciſe degree could not be aſcertained.

69 Air and water to be eſſentially different;

The only uſe to be made of this obſervation at preſent is, that ſince we have been able to exhibit air in a denſity a thouſand times greater than the ordinary denſity of the air we breathe, it cannot, as ſome imagine, be only a different form of water; for in this ſtate it is as denſe or denſer than water, and yet retains its great expanſibility.

70 And ſhow the error of ſome opinions reſpecting elaſticity, &c.

Another important obſervation is, that in every ſtate of denſity in which we find it, it retains its perfect fluidity, tranſmitting all preſſures which are applied to it with undiminiſhed force, as appears by the equality conſtantly obſerved between the oppoſing columns of water or other fluid by which it is compreſſed, and by the facility with which all motions are performed in it in the moſt compreſſed ſtates in which we can make obſervations of this kind. This fact is totally incompatible with the opinion of thoſe who aſcribe the elaſticity of air to the ſpringy ramified ſtructure of its particles, touching each other like ſo many pieces of ſponge or foot-balls. A collection of ſuch particles might indeed be pervaded by ſolid bodies with conſiderable eaſe, if they were merely touching each other, and not ſubjected to any external preſſure. But the moment ſuch preſſure is exerted, and the aſſemblage ſqueezed into a ſmaller ſpace, each preſſes on its adjoining particles: they are individually compreſſed, flattened in their touching ſurfaces, and *before the denſity is doubled* they are ſqueezed into the form of perfect cubes, and compoſe a maſs, which may indeed propagate preſſure from one place to another in an imperfect manner, and with great diminution of its intenſity, but will no more be fluid than a maſs of ſoft clay. It will be of uſe to keep this obſervation in mind.

71 Conſequences of the air's elaſticity.

We have ſeen that air is heavy and compreſſible, and might now proceed to deduce in order the explanation of the appearances conſequent on each of theſe properties. But, as has been already obſerved, the elaſticity of air modifies the effects of its gravity ſo remarkably, that they would be imperfectly underſtood if both qualities were not combined in our conſideration of either. At any rate, ſome farther conſequences of its elaſticity muſt be conſidered, before we underſtand the means of varying at pleaſure the effects of its gravity.

72 Its great expanſibility.

Since air is heavy, the lower ſtrata of a maſs of air muſt ſupport the upper; and, being compreſſible, they muſt be condenſed by their weight. In this ſtate of compreſſion the elaſticity of the lower ſtrata of air acts in oppoſition to the weight of the incumbent air, and balances it. There is no reaſon which ſhould make us ſuppoſe that its expanding force belongs to it only when in ſuch a ſtate of compreſſion. It is more probable, that if we could free it from this preſſure, the air would expand itſelf into ſtill greater bulk. This is moſt diſtinctly ſeen in the following experiment.

73 Proved by experiment.

Into the cylindric jar ABCD (fig. 11.), which has a ſmall hole in its bottom, and is furniſhed with an air-tight piſton E, put a ſmall flaccid bladder, having its mouth tied tight with a ſtring. Having puſhed the piſton near to the bottom, and noticed the ſtate of the bladder, ſtop up the hole in the bottom of the jar with the finger and draw up the piſton, which will require a conſiderable force. You will obſerve the bladder ſwell out as if air had been blown into it; and it will again collapſe on allowing the piſton to deſcend. Nothing can be more unexceptionable than the concluſion from this experiment, that ordinary air is in a ſtate of compreſſion, and that its elaſticity is not limited to this ſtate. The bladder being flaccid, ſhows that the included air is in the ſame ſtate with the air which ſurrounds it; and the ſame muſt be affirmed of it while it ſwells but ſtill remains flaccid. We muſt conclude, that the whole air within the veſſel expands, and continues to fill it, when its capacity has been enlarged. And ſince this is obſerved to go on as long as we give it more room, we conclude, that by ſuch experiments we have not yet given it ſo much room as it can occupy.

74 Attempts to diſcover the limits of this expanſion by

It was a natural object of curioſity to diſcover the limits of this expanſion; to know what was the natural unconſtrained bulk of a quantity of air, beyond which it would not expand though all external compreſſing force were removed. Accordingly philoſophers conſtructed inſtruments for *rarefying* the air. The common water-pump had been long familiar, and appeared very proper for this purpoſe. The moſt obvious is the following.

75 A ſyringe;

Let the barrel of the ſyringe AB (fig. 12.) communicate with the veſſel V, with a ſtopcock C between them. Let it communicate with the external air by another orifice D, in any convenient ſituation, alſo furniſhed with a ſtopcock. Let this ſyringe have a piſton very accurately fitted to it ſo as to touch the bottom all over when puſhed down, and have no vacancy about the ſides.

76 From the operation of which

Now ſuppoſe the piſton at the bottom, the cock C open, and the cock D ſhut, draw the piſton to the top. The air which filled the veſſel V will expand ſo as to fill both that veſſel and the barrel AB; and as no reaſon can be given to the contrary, we muſt ſuppoſe that the air will be uniformly diffuſed through both. Calling V and B the capacity of the veſſel and barrel, it is plain that the bulk of the air will now be V+B; and ſince the quantity of matter remains the ſame, and the denſity of a fluid is as its quantity of matter directly and its bulk inverſely, the denſity of the expanded air will be $\frac{V}{V+B}$, the denſity of common air being 1: for $V+B:V=1:\frac{V}{V+B}$.

77 We infer the diminution of the elaſticity of expanded air,

The piſton requires force to raiſe it, and it is raiſed in oppoſition to the preſſure of the incumbent atmoſphere; for this had formerly been balanced by the elaſticity of the common air: and we conclude from the fact, *that force is required to raiſe the piſton*, that the elaſticity of the expanded air is leſs than that of air in its ordinary ſtate; and an accurate obſervation of the force neceſſary to raiſe it would ſhow how much the elaſticity is diminiſhed. When therefore the piſton is let go, it will deſcend as long as the preſſure of the atmoſphere exceeds the elaſticity of the air in the barrel; that is, till the air in the barrel is in a ſtate of ordinary denſity. To put it further down will require force, becauſe the air muſt be compreſſed in the barrel; but if we now open the cock D, the air will be expelled through it, and the piſton will reach the bottom.

78 And calculate its denſity.

Now ſhut the *diſcharging cock* D, and open the cock C, and draw up the piſton. The air which occupied the ſpace V, with the denſity $\frac{V}{V+B}$, will now occupy the ſpace V+B, if it expands ſo far. To have its denſity D, ſay, As its preſent bulk V+B is to its former bulk V, ſo is its former denſity $\frac{V}{V+B}$ to its new denſity; which will therefore be $\frac{V\times V}{\overline{V+B}\times\overline{V+B}}$, or $\overline{\frac{V}{V+B}}\Big|^{2}$.

79

It is evident, that if the air continues to expand, the denſity of the air in the veſſel after the third drawing up the piſton will be $\overline{\frac{V}{V+B}}\Big|^{3}$, after the fourth it will be $\overline{\frac{V}{V+B}}\Big|^{4}$, and after any number of ſtrokes *n* will be $\overline{\frac{V}{V+B}}\Big|^{n}$. Thus if a veſſel is four times as large as the barrel, the denſity after the fifth ſtroke will be $\frac{1024}{3125}$, nearly $\frac{1}{3}$ of its ordinary denſity.

80

On the other hand, the number *n* of ſtrokes neceſſary for reducing air to the denſity D is $\frac{\text{Log } D}{\text{Log } V-\text{Log }(V+B)}$.

81 Some inconveniences of this inſtrument.

Thus we ſee that this inſtrument can never abſtract the whole air in conſequence of its expanſion, but only rarefy it continually as long as it continues to expand; nay, there is a limit beyond which the rarefaction cannot go. When the piſton has reached the bottom, there remains a ſmall ſpace between it and the cock C filled with common air. When the piſton is drawn up, this ſmall quantity of air expands, and alſo a ſimilar quantity in the neck of the other cock; and no air will come out of the receiver V till the expanded air in the barrel is of a ſmaller denſity than the air in the receiver. This circumſtance evidently directs us to make theſe two ſpaces as ſmall as poſſible, or by ſome contrivance to fill them up altogether. Perhaps this may be done effectually in the following manner.

82 Remedied by another.

Let BE (fig. 13.) repreſent the bottom of the barrel, and let the circle HKI be the ſection of the key of the cock, of a large diameter, and place it as near to the barrel as can be. Let this communicate with the barrel by means of an hole FG widening upwards, as the fruſtum of a hollow obtuſe cone. Let the bottom of the piſton *b f h g e* be ſhaped ſo as to fit the bottom of the barrel and this hole exactly. Let the cock be pierced with two holes. One of them, HI, paſſes perpendicularly through its axis, and forms the communication between the receiver and barrel. The other hole, KL, has one extremity K on the ſame circumference with H, ſo that when the key is turned a fourth part round, K will come into the place of H: but this hole is piereed obliquely into the key, and thus keeps clear of the hole HI. It goes no further than the axis, where it communicates with a hole bored along the axis and terminating at its extremity. This hole forms the communication with the external air, and ſerves for diſcharging the air in the barrel. (A ſide view of the key is ſeen in fig. 14.) Fig. 12. ſhows the poſition of the cock while the piſton is moving upwards, and fig. 14. ſhows its poſition while the piſton is moving downwards. When the piſton has reached the bottom, the conical piece *f h g* of the piſton, which may be of firm leather, fills the hole FHG, and therefore completely expels the air from the barrel. The canal KL*l* of the cock contains air of the common denſity; but this is turned aſide into the poſition KL (fig. 13.), while the piſton is ſtill touching the cock. It cannot expand into the barrel during the aſcent of the piſton. In place of it the perforation HLI comes under the piſton, filled with air that had been turned aſide with it when the piſton was at the top of the barrel, and therefore of the ſame denſity with the air of the receiver. It appears therefore that there is no limit to the rarefaction as long as the air will expand.

83 Called an exhauſting ſyringe.

This inſtrument is called an EXHAUSTING SYRINGE. It is more generally made in another form, which is much leſs expenſive, and more convenient in its uſe. Inſtead of being furniſhed with *cocks* for eſtabliſhing the communications and ſhutting them, as is neceſſary, it has *valves* like thoſe of the condenſing ſyringe, but opening in the oppoſite direction. It is thus made:

84 Its conſtruction and

The pipe of communication or conduit MN (fig. 15.), has a male ſcrew in its extremity, and over this is tied a ſlip of bladder or leather M. The lower half of the piſton has alſo a male ſcrew on it, covered at the end with a ſlip of bladder O. This is ſcrewed into the upper half of the piſton, which is pierced with a hole H coming out of the ſide of the rod.

85 Operation.

Now ſuppoſe the ſyringe ſcrewed to the conducting pipe, and that ſcrewed into the receiver V, and the piſton at the bottom of the barrel. When the piſton is drawn up, the preſſure of the external air ſhuts the valve O, and a void is left below the piſton: there is therefore no preſſure on the upper ſide of the valve M to balance the elaſticity of the air in the receiver which formerly balanced the weight of the atmoſphere. The air therefore in the receiver lifts this valve, and diſtributes itſelf between the veſſel and the barrel; ſo that when the piſton has reached the top the denſity of the air in both receiver and barrel is as before $\frac{V}{V+B}$.

86 When the piſton is let go it deſcends, becauſe the elaſticity of the expanded air is not a balance for the preſſure of the atmoſphere, which therefore preſſes down the piſton with the difference, keeping the piſton-valve ſhut all the while. At the ſame time the valve M alſo ſhuts: for it was opened by the prevailing elaſticity of the air in the receiver, and while it is open the two airs have equal denſity and elaſticity; but the moment the piſton deſcends, the capacity of the barrel is diminiſhed, the elaſticity of its air increaſes by collapſing, and now prevailing over that of the air in the receiver ſhuts the valve M.

87 When it has arrived at ſuch a part of the barrel that the air in it is of the denſity of the external air, there is no force to puſh it further down; the hand muſt therefore preſs it. This attempts to condenſe the air in the barrel, and therefore increaſes its elaſticity; ſo that it lifts the valve O and eſcapes, and the piſton gets to the bottom. When drawn up again, greater force is required than the laſt time, becauſe the elaſticity of the included air is leſs than in the former ſtroke. The piſton riſes further before the valve M is lifted up, and when it has reached the top of the barrel the denſity of the included air is $\overline{\frac{V}{V+B}}\Big|^{2}$. The piſton, when let go, will deſcend further than it did before ere the piſton-valve open, and the preſſure of the hand will again puſh it to the bottom, all the air eſcaping through O. The rarefaction will go on at every ſucceſſive ſtroke in the ſame manner as with the other ſyringe.

88 Advantage of this ſyringe over the former, and

This ſyringe is evidently more eaſy in its uſe, requiring no attendance to the cocks to open and ſhut them at the proper times. On this account this conſtruction of an exhauſting ſyringe is much more generally uſed.

89 Its inferiority.

But it is greatly inferior to the ſyringe with cocks with reſpect to its power of rarefaction. Its operation is greatly limited. It is evident that no air will come out of the receiver unleſs its elaſticity *exceed* that of the air in the barrel by a difference able to lift up the valve M. A piece of oiled leather tied acroſs this hole can hardly be made tight and certain of clapping to the hole without ſome ſmall ſtraining, which muſt therefore be overcome. It muſt be very gentle indeed not to require a force equal to the weight of two inches of water, and this is equal to about the 200th part of the whole elaſticity of the ordinary air; and therefore this ſyringe, for this reaſon alone, cannot rarefy air above 200 times, even though air were capable of an indefinite expanſion. In like manner the valve O cannot be raiſed without a ſimilar prevalence of the elaſticity of the air in the barrel above the weight of the atmoſphere. Theſe cauſes united, make it difficult to rarefy the air more than 100 times, and very few ſuch ſyringes will rarefy it more than 50 times; whereas the ſyringe with cocks, when new and in good order, will rarefy it 1000 times.

90 The former ſyringe, however, more liable to go out of order.

But, on the other hand, ſyringes with cocks are much more expenſive, eſpecially when furniſhed with apparatus for opening and ſhutting the cocks. They are more difficult to make equally tight, and (which is the greateſt objection) do not remain long in good order. The cocks, by ſo frequently opening and ſhutting, grow looſe, and allow the air to eſcape. No method has been found of preventing this. They muſt be ground tight by means of emery or other cutting powders. Some of theſe unavoidably ſtick in the metal, and continue to wear it down. For this reaſon philoſophers, and the makers of philoſophical inſtruments, have turned their chief attention to the improvement of the ſyringe with valves. We have been thus minute in the account of the operation of rarefaction, that the reader may better underſtand the value of theſe improvements, and in general the operation of the principal pneumatic engines.

Of the Air-Pump.

91 Invention of the air-pump by Guericke.

An Air-Pump is nothing but an exhauſting ſyringe accommodated to a variety of experiments. It was firſt invented by Otto Guericke, a gentleman of Magdeburgh in Germany, about the year 1654. We truſt that it will not be unacceptable to our readers to ſee this inſtrument, which now makes a principal article in a philoſophical apparatus, in its firſt form, and to trace it through its ſucceſſive ſteps to its preſent ſtate of improvement.

Guericke, indifferent about the ſolitary poſſeſſion of an invention which gave entertainment to numbers who came to ſee his wonderful experiments, gave a minute deſcription of all his pneumatic apparatus to Gaſpar Schottus profeſſor of mathematics at Wirtemberg, who immediately publiſhed it with the author's conſent, with an account of ſome of its performances, firſt in 1657, in his *Mechanica Hydraulico-pneumatica*; and then in his *Technica Curioſa*, in 1664, a curious collection of all the wonderful performances of art which he collected by a correſpondence over all Europe.

92 Conſtruction of his pump.

Otto Guericke's air-pump conſiſts of a glaſs receiver A (fig. 16.), of a form nearly ſpherical, fitted up with a braſs cap and cock B. The nozzle of the cap was fixed to a ſyringe CDE, alſo of braſs, bent at D into half a right angle. This had a valve at D, opening from the receiver into the ſyringe, and ſhutting when preſſed in the oppoſite direction. In the upper ſide of the ſyringe there is another valve F, opening from the ſyringe into the external air, and ſhutting when preſſed inwards. The piſton had no valve. The ſyringe, the cock B, and the joint of the tube, were immerſed in a ciſtern filled with water. From this deſcription it is eaſy to underſtand the operation of the inſtrument. When the piſton was drawn up from the bottom of the ſyringe, the valve F was kept ſhut by the preſſure of the external air, and the valve D opened by the elaſticity of the air in the receiver. When it was puſhed down again, the valve D immediately ſhut by the ſuperior elaſticity of the air in the ſyringe; and when this was ſufficiently compreſſed, it opened the valve F, and was diſcharged. It was immerſed in water, that no air might find its way through the joints or cocks.

93 Its imperfections.

It would ſeem that this machine was not very perfect, for Guericke ſays that it took ſeveral hours to produce an evacuation of a moderate-ſized veſſel; but he ſays, that when it was in good order, the rarefaction (for he acknowledged that it was not, nor could be, a complete evacuation) was ſo great, that when the cock was opened, and water admitted, it filled the receiver ſo as ſometimes to leave no more than the bulk of a pea filled with air. This is a little ſurpriſing; for if the valve F be placed as far from the bottom of the ſyringe as in Schottus's figure, it would appear that the rarefaction could not be greater than what muſt ariſe from the air in DF expanding till it filled the whole ſyringe: becauſe as ſoon as the piſton in its deſcent paſſes F it can diſcharge no more air, but muſt compreſs it between F and the bottom, to be expanded again when the piſton is drawn up. It is probable that the piſton was not very tight, but that on preſſing it down it allowed the air to paſs it; and the water in which the whole was immerſed prevented the return of the air when it was drawn up again: and this accounts for the great time neceſſary for producing the deſired rarefaction.

94 His improvement of it.

Guericke, being a gentleman of fortune, ſpared no expence, and added a part to the machine, which ſaved his numerous viſitants the trouble of hours attendance before they could ſee the curious experiments with the rarefied air. He made a large copper veſſel G (fig. 17.), having a pipe and cock below, which paſſed through the floor of the chamber into an under apartment, where it was joined to the ſyringe immerſed in the ciſtern of water, and worked by a lever. The upper part of the veſſel terminated in a pipe, furniſhed with a ſtopcock H, ſurrounded with a ſmall brim to hold water for preventing the ingreſs of air. On the top was another cap I, alſo filled with water, to protect the junction of the pipes with the receiver K. This great veſſel was always kept exhauſted, and workmen attended below. When experiments were to be performed in the receiver K, it was ſet on the top of the great veſſel, and the cock H was opened. The air in K immediately diffuſed itſelf equally between the two veſſels, and was ſo much more rarefied as the receiver K was ſmaller than the veſſel G. When this rarefaction was not ſufficient, the attendants below immediately worked the pump.

Theſe particulars deſerve to be recorded, as they ſhow the inventive genius of this celebrated philoſopher, and becauſe they are uſeful even in the preſent advanced ſtate of the ſtudy. Guericke's method of excluding air from all the joints of his apparatus, by immerſing theſe joints in water, is the only method that has to this day been found effectual; and there frequently occur experiments where this excluſion for a long time is abſolutely neceſſary. In ſuch caſes it is neceſſary to conſtruct little cups or ciſterns at every joint, and to fill them with water or oil. In a letter to Schottus, 1662-3, he deſcribes very ingenious contrivances for producing complete rarefaction after the elaſticity of the remaining air has been ſo far diminiſhed that it is not able to open the valves. He opens the exhauſting valves by a plug, which is puſhed in by the hand; and the diſcharging valve is opened by a ſmall pump placed on its outſide, ſo that it opens into a void inſtead of opening againſt the preſſure of the atmoſphere. (See *Schotti Technica Curioſa*, p. 68, 70.) Theſe contrivances have been lately added to air-pumps by Haas and Hurter as new inventions.

It muſt be acknowledged, that the application of the pump or ſyringe to the exhauſtion of air was a very obvious thought on the principle exhibited in n° 17. and in this way it was alſo employed by Guericke, who firſt filled the receiver with water, and then applied the ſyringe. But this was by no means either his object or his

Fig. 11

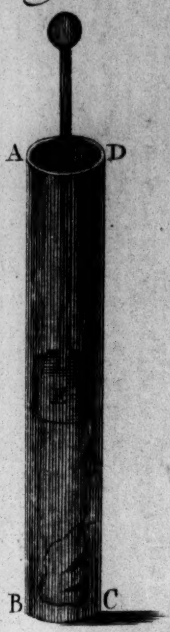
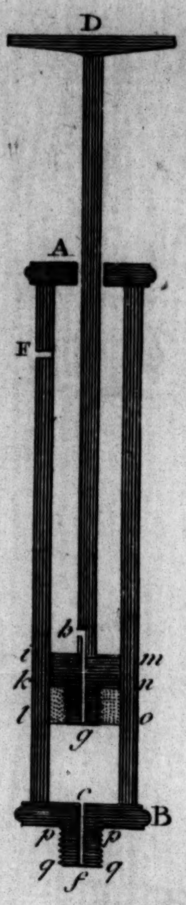


Fig. 10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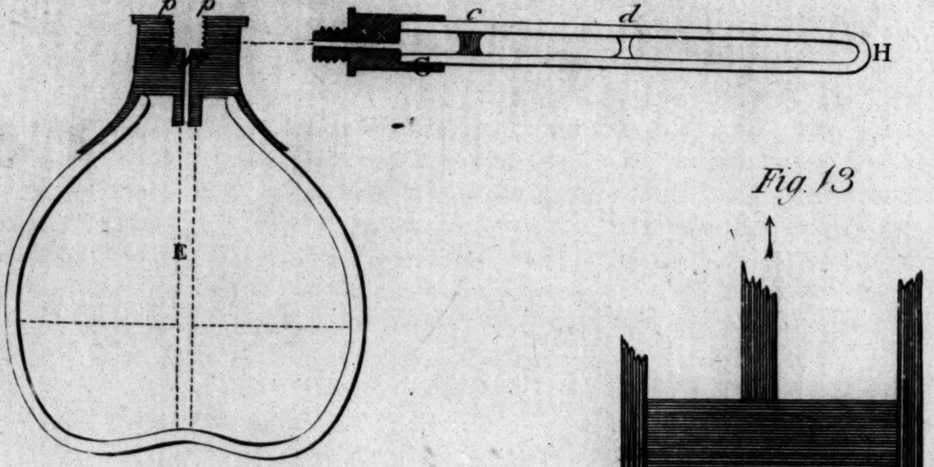

Fig. 16

Fig. 17

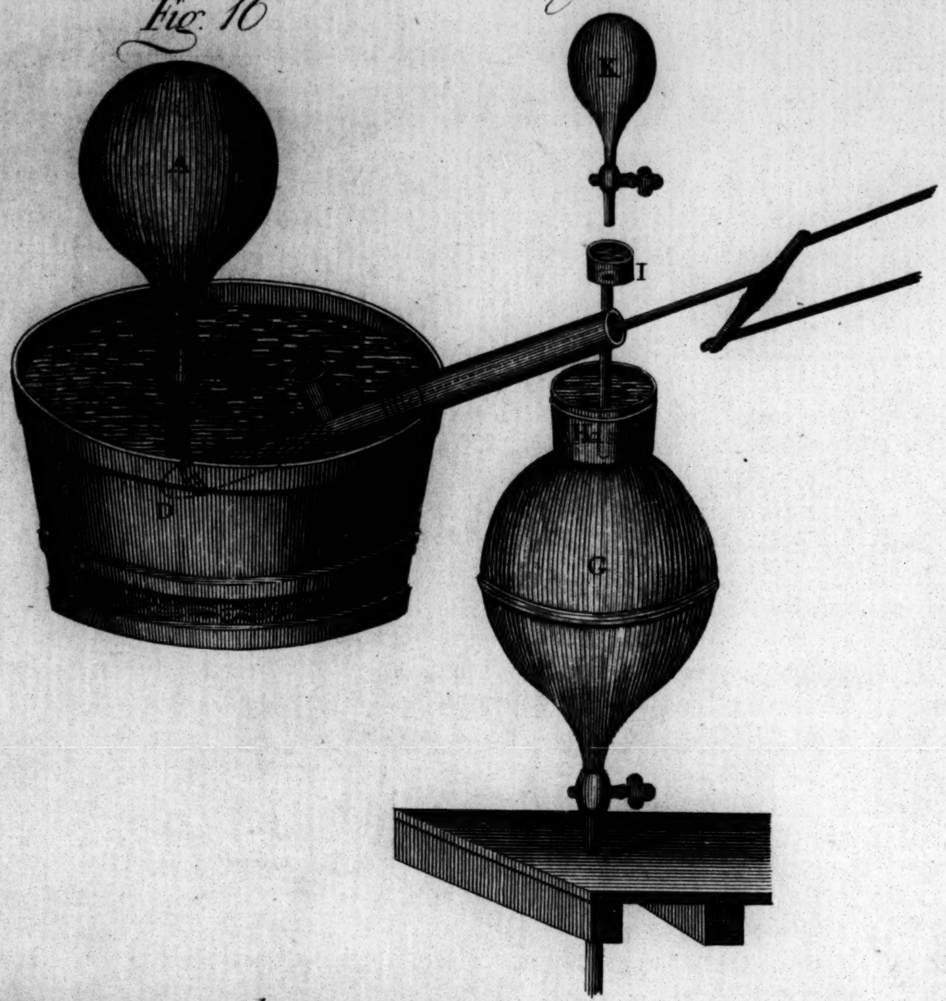

Fig. 12

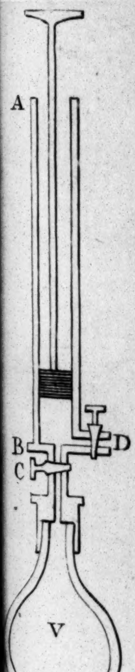

Fig. 13

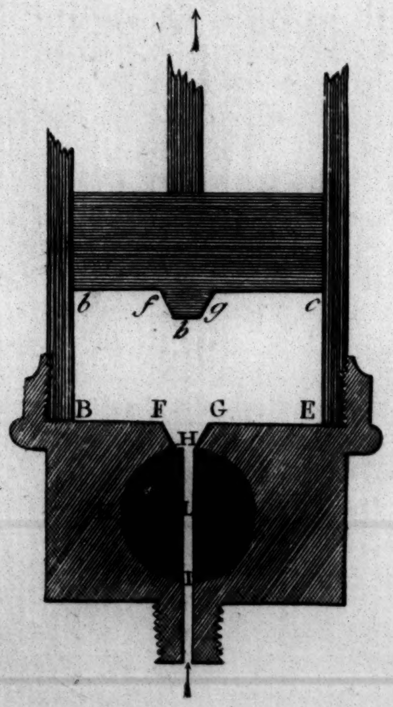
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Fig. 15

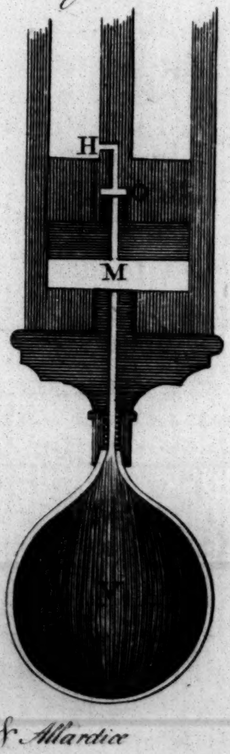
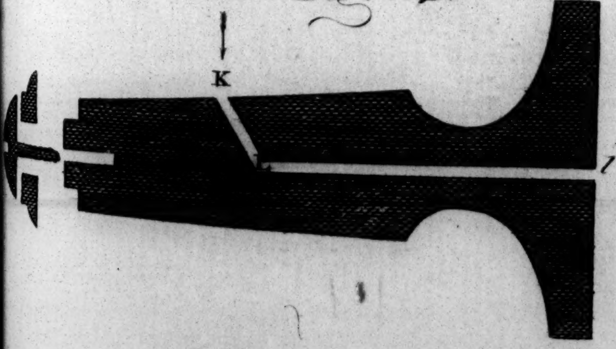


Fig. 14.



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95 Merits of Guericke.

his principle. His object was not ſolely to procure a veſſel void of air, but to exhauſt the air which was already in it; and his principle was the power which he ſuſpected to be in air of expanding itſelf into a greater ſpace when the force was removed which he ſuppoſed to compreſs it. He expreſsly ſays (*Tract. de Experimentis Magdeburgicis, et in Epiſt. ad Schottum*), that the contrivance occured to him accidentally when occupied with experiments in the Torricellian tube, in which he found that the air would really expand, and completely fill a much larger ſpace than what it uſually occupied, and that he had found no limits to the expanſion, evincing this by facts which we ſhall perfectly underſtand by and by. This was a doctrine quite new, and required a philoſophical mind to view it in a general and ſyſtematic manner; and it muſt be owned that his manner of treating the ſubject is equally remarkable for ingenuity and for modeſty. (*Epiſt. ad Scottum.*)

96 Progreſs of experimental philoſophy.

His doctrine and his machine were ſoon ſpread over Europe. It was the age of literary ardour and philoſophical curioſity; and it is moſt pleaſant to us, who ſtanding on the ſhoulders of our predeceſſors, can ſee far around us, to obſerve the eagerneſs with which every new, and to us frivolous, experiment was repeated and canvaſſed. The worſhippers of Ariſtotle were daily receiving ſevere mortifications from the experimenters, or empirics as they affected to call them, and they exerted themſelves ſtrenuouſly in ſupport of his now tottering cauſe. This contributed to the rapid propagation of every diſcovery; and it was a moſt profitable and reſpectable buſineſs to go through the chief cities of Germany and France exhibiting philoſophical experiments.

97 Ardour of Mr Boyle.

About this time the foundations of the Royal Society of London were laid. Mr Boyle, Mr Wren, Lord Brounker, Dr Wallis, and other curious gentlemen, held meetings at Oxford, in which were received accounts of whatever was doing in the ſtudy of nature; and many experiments were exhibited. The reſearches of Galileo, Toricelli, and Paſchal concerning the preſſure of the air, greatly engaged their attention, and many additions were made to their diſcoveries. Mr Boyle, the moſt ardent and ſucceſsful ſtudier of nature, had the principal ſhare in theſe improvements, his inquiſitive mind being aided by an opulent fortune. In a letter to his nephew Lord Dungarvon, he ſays that he had made many attempts to ſee the appearances exhibited by bodies freed from the preſſure of the air. He had made Toricellian tubes, having a ſmall veſſel a-top, into which he put ſome bodies before filling the tubes with mercury; ſo that when the tube was ſet upright, and the mercury run out, the bodies were *in vacuo*. He had alſo abſtracted the water from a veſſel, by a ſmall pump, by means of its weight, in the manner deſcribed in nº 17, having previouſly put bodies into the veſſel along with the water. But all theſe ways were very troubleſome and imperfect. He was delighted when he learned from Schottus's firſt publication, that Counſellor Guericke had effected this by the expanſive power of the air; and immediately ſet about conſtructing a machine from his own ideas, no deſcription of Guericke's being then publiſhed.

Plate CCCCI.

98 His air-pump.

It conſiſted of a receiver A (fig. 18.) furniſhed with a ſtopcock B, and ſyringe CD placed in a vertical poſition below the receiver. Its valve C was in its bottom, cloſe adjoining to the entry of the pipe of communication; and the hole by which the air iſſued was farther ſecured by a plug which could be removed. The piſton was moved by a wheel and rackwork. The receiver of Guericke's pump was but ill adapted for any conſiderable variety of experiments; and accordingly very few were made in it. Mr Boyle's receiver had a large opening EF, with a ſtrong glaſs margin. To this was fitted a ſtrong braſs cap, pierced with a hole G in its middle, to which was fitted a plug ground into it, and ſhaped like the key of a cock. The extremity of this key was furniſhed with a ſcrew, to which could be affixed a hook, or a variety of pieces for ſupporting what was to be examined in the receiver, or for producing various motions within it, without admitting the air. This was farther guarded againſt by means of oil poured round the key, where it was retained by the hollow cup-like form of the cover. With all theſe precautions, however, Mr Boyle ingeniouſly confeſſes, that it was but ſeldom, and with great difficulty, that he could produce an extreme degree of rarefaction; and it appears by Guericke's letter to Schottus, that in this reſpect the Magdeburgh machine had the advantage. But moſt of Boyle's very intereſting experiments did not require this extreme rarefaction; and the variety of them and their philoſophic importance, compenſated for this defect, and ſoon eclipſed the fame of the inventor to ſuch a degree, that the ſtate of air in the receiver was generally denominated the *vacuum Boyleanum*, and the air-pump was called *machina Boyleana*. It does not appear that Guericke was at all ſolicitous to maintain his claim to priority of invention. He appears to have been of a truly noble and philoſophical mind, aiming at nothing but the advancement of ſcience.

99 His contrivances to make air-veſſels tight.

Mr Boyle found, that to make a veſſel air-tight, it was ſufficient to place a piece of wet or oiled leather on its brim, and to lay a flat plate of metal upon this. The preſſure of the external air ſqueezed the two ſolid bodies ſo hard together, that the ſoft leather effectually excluded it. This enabled him to render the whole machine incomparably more convenient for a variety of experiments. He cauſed the conduit-pipe to terminate in a flat plate which he covered with leather, and on this he ſet the glaſs ball or receiver, which had both its upper and lower brim ground flat. He covered the upper orifice in like manner with a piece of oiled leather and a flat plate, having cocks and a variety of other perforations and contrivances ſuited to his purpoſes. This he found infinitely more expeditious, and alſo tighter, than the clammy cements which he had formerly uſed for ſecuring the joints.

100 Dr Hooke's improvement of Boyle's air-pump.

He was now aſſiſted by Dr Hooke, the moſt ingenious and inventive mechanic that the world has ever ſeen. This perſon made a great improvement on the air-pump, by applying two ſyringes whoſe piſton-rods were worked by the ſame wheel, as in fig. 20, nº 1, and putting valves in the piſtons in the ſame manner as in the piſton of a common pump. This evidently doubled the expedition of the pump's operation; but it alſo greatly diminiſhed the labour of pumping; for it muſt be obſerved, that the piſton H muſt be drawn up againſt the preſſure of the external air, and when the rarefaction is nearly perfect this requires a force of nearly 15 pounds for every inch of the area of the piſton. Now when one piſton H is at the bottom of the barrel, the other K is at the top of the barrel, and the air below K is equally rare with that in the receiver. Therefore the preſſure of the external air on the piſton K is *nearly* equal to that on the piſton H. Both, therefore, are acting in oppoſite directions on the wheel which gave them motion; and the force neceſſary for raiſing H is only the difference between the elaſticity of the air in the barrel H and that of the air in the barrel K. This is very ſmall in the beginning of the ſtroke, but gradually increaſes as the piſton K deſcends, and becomes equal to the whole exceſs of the air's preſſure above the elaſticity of the remaining air of the receiver when the air at K of the natural denſity begins to open the piſton valves. An accurate attention to the circumſtances will ſhow us that the force requiſite for working the pump is greateſt at firſt, and gradually diminiſhes as the rarefaction advances; and when this is nearly complete, hardly any more force is required than what is neceſſary for overcoming the friction of the piſtons, except during the diſcharge of the air at the end of each ſtroke.

101 Generally adopted. This is therefore the form of the air-pump which is moſt generally uſed all over Europe. Some traces of national prepoſſeſſion remain. In Germany, air-pumps are frequently made after the original model of Guericke's (Wolff Cyclomatheſis); and the French generally uſe the pump made by Papin, though extremely aukward. We ſhall give a deſcription of Boyle's air-pump as finally improved by Hawkeſbee, which, with ſome ſmall accommodations to particular views, ſtill remains the moſt approved form.

102 Hawkeſbee's improvements. Plate CCCCI. Here follows the deſcription from Deſaguliers.

It conſiſts of two braſs barrels *a a*, *aa* (fig. 19.), 12 inches high and 2 wide. The piſtons are raiſed and depreſſed by turning the winch *bb*. This is faſtened to an axis paſſing through a ſtrong toothed wheel, which lays hold of the teeth of the racks *c c c c*. Then the one is raiſed while the other is depreſſed; by which means the valves, which are made of limber bladder, fixed in the upper part of each piſton, as well as in the openings into the bottom of the barrels, perform their office of diſcharging the air from the barrels, and admitting into them the air from the receiver to be afterwards diſcharged; and when the receiver comes to be pretty well exhauſted of its air, the preſſure of the atmoſphere in the deſcending piſton is nearly ſo great, that the power required to raiſe the other is little more than is neceſſary for overcoming the friction of the piſton, which renders this pump preferable to all others, which require more force to work them as the rarefaction of the air in the receiver advances.

103 Barrels. The barrels are ſet in a braſs diſh about two inches deep, filled with water or oil to prevent the inſinuation of air. The barrels are ſcrewed tight down by the nuts *e e*, *e e*, which force the frontiſpiece *f f* down on them, through which the two pillars *g g*, *g g* paſs.

104 Braſs pipe, &c. From between the barrels riſes a ſlender braſs pipe *h h*, communicating with each by a perforation in the tranſverſe piece of braſs on which they ſtand. The upper end of this pipe communicates with another perforated piece of braſs, which ſcrews on underneath the plate *i i i i*, of ten inches, diameter and ſurrounded with a braſs rim to prevent the ſhedding of water uſed in ſome experiments. This piece of braſs has three branches: 1ſt, An horizontal one communicating with the conduit-pipe *h h*. 2. An upright one ſcrewed into the middle of the pump-plate, and terminating in a ſmall pike *k*, riſing about an inch above it. 3d, Is a perpendicular one, looking downwards in the continuation of the pipe *k*, and having a hollow ſcrew in its end receiving the braſs cap of the gage-pipe *l l l l*, which is of glaſs, 34 inches long, and immerſed in a glaſs ciſtern *m m* filled with mercury. This is covered a-top with a cork float, carrying the weight of a light wooden ſcale divided into inches, which are numbered from the ſurface of the mercury in the ciſtern. This ſcale will therefore riſe and fall with the mercury in the ciſtern, and indicate the true elevation of that in the tube.

105 Stopcock. There is a ſtopcock immediately above the inſertion of the gage-pipe, by which its communication may be cut off. There is another at *n*, by which a communication is opened with the external air for allowing its readmiſſion; and there is ſometimes another immediately within the inſertion of the conduct-pipe for cutting off the communication between the receiver and the pump. This is particularly uſeful when the rarefaction is to be continued long, as there are by theſe means fewer chances of the inſinuation of air by the many joints.

106 Receivers. The receivers are made tight by ſimply ſetting them on the pump-plate with a piece of wet or oiled leather between; and the receivers, which are open a-top, have a braſs cover ſet on them in the ſame manner. In theſe covers there are various perforations and contrivances for various purpoſes. The one in the figure has a ſlip wire paſſing through a collar of oiled leather, having a hook or a ſcrew in its lower end for hanging any thing on or producing a variety of motions.

107 Contrivance for removing them. Sometimes the receivers are ſet on another plate, which has a pipe ſcrewed into its middle, furniſhed with a ſtopcock and a ſcrew, which fits the middle pipe *k*. When the rarefaction has been made in it, the cock is ſhut, and then the whole may be unſcrewed from the pump, and removed to any convenient place. This is called a *tranſporter plate*.

108 Principle upon which the gage is conſtructed. It only remains to explain the gage *l l l l*. In the ordinary ſtate of the air its elaſticity balances the preſſure of the incumbent atmoſphere. We find this from the force that is neceſſary to ſqueeze it into leſs bulk in oppoſition to this elaſticity. Therefore the elaſticity of the air increaſes with the vicinity of its particles. It is therefore reaſonable to expect, that when we allow it to occupy more room, and its particles are farther aſunder, its elaſticity will be diminiſhed though not annihilated; that is, it will no longer balance the WHOLE preſſure of the atmoſphere, though it may ſtill balance part of it. If therefore an upright pipe have its lower end immerſed in a veſſel of mercury, and communicate by its upper end with a veſſel containing rarefied, therefore leſs elaſtic, air, we ſhould expect that the preſſure of the air will prevail, and force the mercury into the tube, and cauſe it to riſe to ſuch an height that the weight of the mercury, joined to the elaſticity of the rarefied air acting on its upper ſurface, ſhall be exactly equal to the whole preſſure of the atmoſphere. The height of the mercury is the exact meaſure of that part of the whole preſſure which is not balanced by the elaſticity of the rarefied air, and its deficiency from the height of the mercury in the Toricellian tube is the exact meaſure of this remaining elaſticity.

109
So as to indicate the degree of rarefaction

It is evident therefore, that the pipe will be a ſcale of the elaſticity of the remaining air, and will indicate in ſome ſort the degree of rarefaction: for there muſt be ſome analogy between the denſity of the air and its elaſticity; and we have no reaſon to imagine that they do not increaſe and diminiſh together, although we may be ignorant of the law, that is, of the change of elaſticity correſponding to a known change of denſity. This is to be diſcovered by experiment; and the air-pump itſelf furniſhes us with the beſt experiments for this purpoſe. After rarefying till the mercury in the gage has attained half the height of that in the Toricellian tube, ſhut the communication with the barrels and gage, and admit the water into the receiver. It will go in till all is again in equilibrio with the preſſure of the atmoſphere; that is, till the air in the receiver has collapſed into its natural bulk. This we can accurately meaſure, and compare with the whole capacity of the receiver; and thus obtain the preciſe degree of rarefaction correſponding to half the natural elaſticity. We can do the ſame thing with the elaſticity reduced to one third, one fourth, &c. and thus diſcover the whole law.

110
Inconveniences of this ga

Plate CCCCI.

111
Remedied:

This gage muſt be conſidered as one of the moſt ingenious and convenient parts of Hawkeſbee's pump; and it is well diſpoſed, being in a ſituation protected againſt accidents: but it neceſſarily increaſes greatly the ſize of the machine, and cannot be applied to the table-pump, repreſented in fig. 20, n° 1. When it is wanted here, a ſmall plate is added behind, or between the barrels and receiver; and on this is ſet a ſmall tubulated (as it is termed) receiver, covering a common weather-glaſs tube.—This receiver being rarefied along with the other, the preſſure on the mercury in the ciſtern ariſing from the elaſticity of the remaining air is diminiſhed ſo as to be no longer able to ſupport the mercury at its full height; and it therefore deſcends till the height at which it ſtands puts it in equilibrio with the elaſticity. In this form, therefore, the height of the mercury is directly a meaſure of the remaining elaſticity; while on the other it meaſures the remaining unbalanced preſſure of the atmoſphere. But this gage is extremely cumberſome, and liable to accidents. We are ſeldom much intereſted in the rarefaction till it is great: a contracted form of this gage is therefore very uſeful, and was early uſed. A ſyphon ABCD (fig. 20, n° 2.), each branch of which is about four inches long, cloſe at A and open at D, is filled with boiling mercury till it occupies the branch AB and a very ſmall part of CD, having its ſurface at O. This is fixed to a ſmall ſtand, and fixed into the receiver, along with the things that are to be exhibited in the rarefied air. When the air has been rarefied till its remaining elaſticity is not able to ſupport the column BA, the mercury deſcends in AB, and riſes in CD, and the remaining elaſticity will always be meaſured by the elevation of the mercury in AB above that in the leg CD. Could the exhauſtion be perfected, the ſurfaces in both legs would be on a level. Another gage might be put into the ſame foot, having a ſmall bubble of air at A. This would move from the beginning of the rarefaction; but our ignorance of the analogy between the denſity and elaſticity hinders us from uſing it as a meaſure of either.

112
A complete exhauſtion not effected by the air-pump.

It is enough for our preſent purpoſe to obſerve, that the barometer or ſyphon gage is a perfect indication and meaſure of the performance of an air pump, and that a pump is, (*cæteris paribus*) ſo much the more perfect, as it is able to raiſe the mercury higher in the gage. It is in this way that we diſcover that none can produce a complete exhauſtion, and that their operation is only a very great rarefaction: for none can raiſe the mercury to that height at which it ſtands in the Toricellian tube, well purged of air. Few pumps will bring it within $\frac{1}{10}$ of an inch. Hawkeſbee's, fitted up according to his inſtructions, will ſeldom bring it within $\frac{1}{7}$. Pumps with cocks, when conſtructed according to the principles mentioned when ſpeaking of the exhauſting ſyringe, and new and in fine order, will in favourable circumſtances bring it within $\frac{1}{40}$. None with valves fitted up with wet leather, or when water or volatile fluids are allowed acceſs into any part, will bring it nearer than $\frac{1}{5}$. Nay, a pump of the beſt kind, and in the fineſt order, will have its rarefying power reduced to the loweſt ſtandard, as meaſured by this gage, if we put into the receiver the tenth part of a ſquare inch of white ſheep-ſkin, freſh from the ſhops, or of any ſubſtance equally damp. This is a diſcovery made by means of the improved air-pump, and leads to very extenſive and important conſequences in general phyſics; ſome of which will be treated of under this article: and the obſervation is made thus early, that our readers may better underſtand the improvements which have been made on this celebrated machine.

113
Various improvements of this machine,

It would require a volume to deſcribe all the changes which have been made on it. An inſtrument of ſuch multifarious uſe, and in the hands of curious men, each diving into the ſecrets of nature in his favourite line, muſt have received many alterations and real improvements in many particular reſpects. But theſe are beſide our preſent purpoſe; which is to conſider it merely as a machine for rarefying elaſtic or expanſive fluids. We muſt therefore confine ourſelves to this view of it; and ſhall carefully ſtate to our readers every improvement founded on principle, and on pneumatical laws.

114
By attempting to perfect the conſtruction of the cocks.

All who uſed it perceived the limit ſet to the rarefaction by the reſiſtance of the valves, and tried to perfect the conſtruction of the cocks. The Abbé Nollet and Graveſande, two of the moſt eminent experimental philoſophers in Europe were the moſt ſucceſsful.

115
Graveſande's improvement.

Mr Graveſande juſtly preferred Hooke's plan of a double pump, and contrived an apparatus for turning the cocks by the motion of the pump's handle. This is far from either being ſimple or eaſy in working; and occaſions great jerks and concuſſions in the whole machine. This, however, is not neceſſarily connected with the truly pneumatical improvement. His piſton has no valve, and the rod is connected with it by a ſtirrup D (fig. 21), as in a common pump. The rod has a cylindric part *c p*, which paſſes through the ſtirrup, and has a ſtiff motion in it up and down of about half an inch; being ſtopped by the ſhoulder *c* above and the nut below. The round plate ſupported by this ſtirrup has a ſhort ſquare tube *n d*, which fits tight into the hole of a piece of cork F. The round plate E has a ſquare ſhank *g*, which goes into the ſquare tube *n d*. A piece of thin leather *f*, ſoaked in oil, is put between the cork and the plate E, and another between the cork and the plate which forms the ſole of the ſtirrup. All theſe pieces are ſcrewed together by the nail *e*, whoſe flat head covers the hole *n*. Suppoſe, therefore, the piſton

116 And manner of uſing

touching the bottom of the barrel, and the winch turning to raiſe it again, the friction of the piſton on the barrel keeps it in its place, and the rod is drawn up through the ſtirrup D. Thus the wheel has liberty to turn about an inch; and this is ſufficient for turning the cock, ſo as to cut off the communication with the external air, and to open the communication with the receiver. This being done, and the motion of the winch continued, the piſton is raiſed to the top of the barrel. When the winch is turned in the oppoſite direction, the piſton remains fixed till the cock is turned, ſo as to ſhut the communication with the receiver and open that with the external air.

117 A uſeful contrivance.

This is a pretty contrivance, and does not at firſt appear neceſſary; becauſe the cocks might be made to turn at the beginning and end of the ſtroke without it. But this is juſt poſſible; and the ſmalleſt error of adjuſtment, or wearing of the apparatus, will cauſe them to be open at improper times. Beſides, the cocks are not turned in an inſtant, and are improperly open during ſome very ſmall time; but this contrivance completely obviates this difficulty.

118.

The cock is preciſely ſimilar to that formerly deſcribed, having one perforation diametrically through it and another entering at right angles to this, and after reaching the centre, it paſſes along the axis of the cock, and comes out to the open air.

119 Its inconvenience.

It is evident, that by this conſtruction of the cock, the ingenious improvement of Dr Hooke, by which the preſſure of the atmoſphere on one piſton is made to balance (in great part) the preſſure on the other, is given up: for, whenever the communication with the air is opened, it ruſhes in, and immediately balances the preſſure on the upper ſide of the piſton in this barrel; ſo that the whole preſſure in the other muſt be overcome by the perſon working the pump. Graveſande, aware of this, put a valve on the orifice of the cock; that is, tied a ſlip of wet bladder or oiled leather acroſs it; and now the piſton is preſſed down, as long as the air in the barrel is rarer than the outward air, in the ſame manner as when the valve is in the piſton itſelf.

120 Remedied.

121 Highly extolled, but

This is all that is neceſſary to be deſcribed in Mr Graveſande's air-pump. Its performance is highly extolled by him as far exceeding his former pumps with valves. The ſame preference was given to it by his ſucceſſor Muſchenbroek. But, while they both prepared the piſtons and valves and leathers of the pump, by ſteeping them in oil, and then in a mixture of water and ſpirits of wine, we are certain that no juſt eſtimate could be made of its performance. For with this preparation it could not bring the gage within $\frac{1}{5}$ of an inch of the barometer. We even ſee other limits to its rarefaction: from its conſtruction, it is plain that a very conſiderable ſpace is left between the piſton and cock, not leſs than an inch, from which the air is never expelled; and if this be made extremely ſmall, it is plain that the pump muſt be worked very ſlow, otherwiſe there will not be time for the air to diffuſe itſelf from the receiver into the barrel, eſpecially towards the end, when the expelling force, viz. the elaſticity of the remaining air, is very ſmall. There is alſo the ſame limit to the rarefaction, as in Hooke's or Hawkeſbee's pump, oppoſed by the valve E, which will not open till the air below the piſton is conſiderably denſer than the external air: and this pump ſoon loſt any advantages it poſſeſſed when freſh from the workman's hands, by the cock's growing looſe and admitting air. It is ſurpriſing that Graveſande omitted Hawkeſbee's ſecurity againſt this, by placing the barrels in a diſh filled with oil; which would effectually have prevented this inconvenience.

122 Limited in its operation.

123 In one reſpect inferior to Hawkeſbee's.

124 Advantage of ſhort barrels.

We muſt not omit a ſeemingly paradoxical obſervation of Graveſande, that in a pump conſtructed with valves, and worked with a determined uniform velocity, the required degree of rarefaction is ſooner produced by ſhort barrels than by long ones. It would require too much time to give a general demonſtration of this, but it will eaſily be ſeen by an example. Suppoſe the long barrel, to have equal capacity with the receiver, then at the end of the firſt ſtroke the air in the receiver will have $\frac{1}{2}$ its natural denſity. Now, let the ſhort barrels have half this capacity: at the end of the firſt ſtroke the denſity of the air in the receiver is $\frac{2}{3}$, and at the end of the ſecond ſtroke it is $\frac{4}{9}$, which is leſs than $\frac{1}{2}$, and the two ſtrokes of the ſhort barrel are ſuppoſed to be made in the ſame time with one of the longeſt, &c.

125 Smeaton improves the valve pump.

Hawkeſbee's pump maintained its pre-eminence without rival in Britain, and generally too on the continent, except in France, where every thing took the *ton* of the Academy, which abhorred being indebted to foreigners for any thing in ſcience, till about the year 1750, when it engaged the attention of Mr John Smeaton, a perſon of uncommon knowledge, and ſecond to none but Dr Hooke in ſagacity and mechanical reſource. He was then a maker of philoſophical inſtruments, and made many attempts to perfect the pumps with cocks, but found, that whatever perfection he could bring them to, he could not enable them to preſerve it; and he never would ſell one of this conſtruction. He therefore attached himſelf ſolely to the valve pumps.

126 By enlarging the valve-hole,

The firſt thing was to diminiſh the reſiſtance to the entry of the air from the receiver into the barrels: this he rendered almoſt nothing, by enlarging the ſurface on which this feebly elaſtic air was to preſs. Inſtead of making theſe valves to open by its preſſure on a circle of $\frac{1}{20}$ of an inch in diameter, he made the valve-hole one inch in diameter, enlarging the ſurface 400 times; and, to prevent this piece of thin leather from being burſt by the great preſſure on it, when the piſton in its deſcent was approaching the bottom of the barrel, he ſupported it by a delicate but ſtrong grating, dividing the valve-hole like the ſection of a honey-comb, as repreſented in fig. 22, nº 3; and the ribs of this grating are ſeen edgewiſe in fig. 22, nº 1, at *a b c*.

Plate CCCCI.

127 Changing the ſtructure of the valve, and

The valve was a piece of a thin membrane or oiled ſilk, gently ſtrained over the mouth of the valve-hole, and tied on by a fine ſilk thread wound round it in the ſame manner that the narrow ſlips had been tied on formerly. This done, he cut with a pointed knife the leather round the edge, nearly four quadrantal arcs, leaving a ſmall tongue between each, as in fig. 22, nº 3. The ſtrained valve immediately ſhrinks inwards, as repreſented by the ſhaded parts; and the ſtrain by which it is kept down is now greatly diminiſhed, taking place only at the corners. The gratings being reduced nearly to an edge (but not quite, leſt they ſhould cut), there is very little preſſure to produce adheſion by the clammy oil. Thus it appears, that a very ſmall elaſticity of the air in the receiver will be ſufficient to raiſe the valve; and Mr Smeaton found, that when it was not able to do this at firſt, when only about $\frac{1}{800}$ of the natural elaſticity, it would do it after keeping the piſton up eight or ten ſeconds, the air having been all the while undermining the valve, and gradually detaching it from the grating.

Unfortunately he could not follow this method with the piſton valve. There was not room round the rod for ſuch an expanded valve; and it would have obliged him to have a great ſpace below the valve, from which he could not expel the air by the deſcent of the piſton. His ingenuity hit on a way of increaſing the expelling force through the common valve: he incloſed the rod of the piſton in a collar of leather *l*, through which it moved freely without allowing any air to get paſt its ſides. For greater ſecurity, the collar of leather was contained in a box terminating in a cup filled with oil. As this makes a material change in the principle of conſtruction of the air-pump (and indeed of pneumatic engines in general), and as it has been adopted in all the ſubſequent attempts to improve them, it merits a particular conſideration.

128
Increaſing the expelling force.

129
Structure of his piſton for this purpoſe.
Plate CCCCI.

The piſton itſelf conſiſts of two pieces of braſs faſtened by ſcrews from below. The uppermoſt, which is of one ſolid piece with the rod GH (fig. 22, n° 1.), is of a diameter ſomewhat leſs than the barrel; ſo that when they are ſcrewed together, a piece of leather ſoaked in a mixture of boiled oil and tallow, is put between them; and when the piſton is thruſt into the barrel from above, the leather comes up around the ſide of the piſton, and fills the barrel, making the piſton perfectly air-tight. The lower half of the piſton projects upwards into the upper, which has a hollow *g b c g* to receive it. There is a ſmall hole through the lower half at *a* to admit the air; and a hole *c d* in the upper half to let it through, and there is a ſlip of oiled ſilk ſtrained acroſs the hole *a* by way of valve, and there is room enough left at *b c* for this valve to riſe a little when preſſed from below. The rod GH paſſes through the piece of braſs which forms the top of the barrel ſo as to move freely, but without any ſenſible ſhake: this top is formed into a hollow box, conſiſting of two pieces ECDF and CNOD, which ſcrew together at CD. This box is filled with rings of oiled leather exactly fitted to its diametter, each having a hole in it for the rod to paſs through. When the piece ECDF is ſcrewed down, it compreſſes the leathers; ſqueezing them to the rod, ſo that no air can paſs between them; and, to ſecure us againſt all ingreſs of air, the upper part is formed into a cup EF, which is kept filled with oil.

The top of the barrel is alſo pierced with a hole LK, which riſes above the flat ſurface NO, and has a ſlip of oiled ſilk tied over it to act as a valve; opening when preſſed from below, but ſhutting when preſſed from above.

The communication between the barrel and receiver is made by means of the pipe ABPQ; and there goes from the hole K in the top of the barrel a pipe KRST, which either communicates with the open air or with the receiver, by means of the cock at its extremity T. The conduit pipe ABPQ has alſo a cock at Q, by which it is made to communicate either with the receiver or with the open air. Theſe channels of communication are variouſly conducted and terminated, according to the views of the maker: the ſketch in this figure is ſufficient for explaining the principle, and is ſuited to the general form of the pump, as it has been frequently made by Nairne and other artiſts in London.

130
Superiority of this conſtruction.

Let us now ſuppoſe the piſton at the top of the barrel, and that it applies to it all over, and that the air in the barrel is very much rarefied: in the common pump the piſton valve is preſſed hard down by the atmoſphere, and continues ſhut till the piſton gets far down, condenſes the air below it beyond its natural ſtate, and enables it to force up the valves. But here, as ſoon as the piſton quits the top of the barrel, it leaves a void behind it; for no air gets in round the piſton rod, and the valve at K is ſhut by the preſſure of the atmoſphere. There is nothing now to oppoſe the elaſticity of the air below but the ſtiffneſs of the valve *b c*; and thus the expelling (or more accurately the liberating) force is prodigiouſly increaſed.

131
Shown by an example.

The ſuperiority of this conſtruction will be beſt ſeen by an example. Suppoſe the ſtiffneſs of the valve equal to the weight of $\frac{1}{10}$ of an inch of mercury, when the barometer ſtands at 30 inches, and that the pump gage ſtands at 29.9; then, in an ordinary pump, the valve in the piſton will not riſe till the piſton has got within the 300th part of the bottom of the barrel, and it will leave the valve-hole filled with air of the ordinary denſity. But in this pump the valve will riſe as ſoon as the piſton quits the top of the barrel; and when it is quite down, the valve-hole *a* will contain only the 300th part of the air which it would have contained in a pump of the ordinary form. Suppoſe further, that the barrel is of equal capacity with the receiver, and that both pumps are ſo badly conſtructed, that the ſpace left below the piſton is the 3000th part of the barrel. In the common pump the piſton valve will riſe no more, and the rarefaction can be carried no farther, however delicate the barrel valve may be; but in this pump the next ſtroke will raiſe the gage to 29. 95, and the piſton valve will again riſe as ſoon as the piſton gets half way down the barrel.

The limit to the rarefaction by this pump depends chiefly on the ſpace contained in the hole LK; and in the ſpace *bcd* of the piſton. When the piſton is brought up to the top, and applied cloſe to it, thoſe ſpaces remain filled with air of the ordinary denſity, which will expand as the piſton deſcends, and thus will retard the opening of the piſton valve. The rarefaction will ſtop when the elaſticity of this ſmall quantity of air, expanded ſo as to fill the whole barrel (by the deſcent of the piſton to the bottom), is juſt equal to the force requiſite for opening the piſton valve.

132
It is eaſily worked.

Another advantage attending this conſtruction is, that in drawing up the piſton, we are not reſiſted by the whole preſſure of the air; becauſe the air is rarefied above this piſton as well as below it, and the piſton is in preciſely the ſame ſtate of preſſure as if connected with another piſton in a double pump. The reſiſtance to the aſcent of the piſton is the exceſs of the elaſticity of the air above it over the elaſticity of the air below: this, towards the end of the rarefaction, is very ſmall, while the piſton is near the bottom of the barrel, but gradually increaſes as the piſton riſes, and reduces the air above it into ſmaller dimenſions, and becomes equal to the preſſure of the atmoſphere, when the air above the piſton is of the common denſity. If we ſhould raiſe the piſton ſtill farther, we muſt condenſe the air above it: but Mr Smeaton has here made an iſſue for the air by a ſmall hole in the top of the barrel, covered with a delicate valve. This allows the air to eſcape, and ſhuts again as ſoon as the piſton begins to deſcend, leaving almoſt a perfect void behind it as before.

This pump has another advantage. It may be changed in a moment from a rarefying to a condenſing engine, by ſimply turning the cocks at Q and T. While T communicates with the open air and Q with the receiver, it is a rarefying engine or air-pump: but when T communicates with the receiver, and Q with the open air, it is a condenſing engine.

Plate CCCCII.

133 Deſcription of Smeaton's pump.

Fig. 23. repreſents Mr Smeaton's air-pump as it is uſually made by Nairne. Upon a ſolid baſe or table are ſet up three pillars F, H, H: the pillar F ſupports the pump-plate A; and the pillars H, H, ſupport the front or head, containing a braſs cog-wheel, which is turned by the handle B, and works in the rack C faſtened to the upper end of the piſton rod. The whole is ſtill farther ſteadyed by two pieces of braſs *cb* and *o k*, which connect the pump-plate with the front, and have perforations communicating between the hole *a* in the middle of the plate and the barrel, as will be deſcribed immediately. DE is the barrel of the pump, firmly fixed to the table by ſcrews thro' its upper flanch: *ef dc* is a ſlender braſs tube ſcrewed to the bottom of the barrel, and to the under hole of the horizontal canal *c b*. In this canal there is a cock which opens a communication between the barrel and the receiver, when the key is in the poſition repreſented here: but when the key is at right angles with this poſition, this communication is cut off. If that ſide of the key which is here drawn next to the pump plate be turned outward, the external air is admitted into the receiver; but if turned inwards, the air is admitted into the barrel.

gh is another ſlender braſs pipe, leading from the diſcharging valve at *g* to the horizontal canal *hk*, to the under ſide of which it is ſcrewed faſt. In this horizontal canal there is a cock *n* which opens a paſſage from the barrel to the receiver when the key is in the poſition here drawn; but opens a paſſage from the barrel to the external air when the key is turned outwards, and from the receiver to the external air when the key is turned inwards. This communication with the external air is not immediate but through a ſort of box *i*; the uſe of this box is to receive the oil which is diſcharged through the top valve *g*. In order to keep the pump tight, and in working order, it is proper ſometimes to pour a table-ſpoonful of olive-oil into the hole *a* of the pump-plate, and then to work the pump. The oil goes along the conduit *bcdfe*, gets into the barrel and through the piſton valve, when the piſton is preſſed to the bottom of the barrel, and is then drawn up, and forced through the diſcharging valve *g* along the pipe *gh*, the horizontal paſſage *hn*, and finally into the box *i*. This box has a ſmall hole in its ſide near the top, through which the air eſcapes.

From the upper ſide of the canal *cb* there riſes a ſlender pipe which bends outward and then turns downwards, and is joined to a ſmall box, which cannot be ſeen in this view. From the bottom of this box proceeds downwards the gage-pipe of glaſs, which enters the ciſtern of mercury G fixed below.

On the upper ſide of the other canal at *o* is ſeen a ſmall ſtud, having a ſhort pipe of glaſs projecting horizontally from it, cloſe by and parallel to the front piece of the pump, and reaching to the other canal. This pipe is cloſe at the farther end, and has a ſmall drop of mercury or oil in it at the end *o*. This ſerves as a gage in condenſing, indicating the degree of condenſation by the place of the drop: For this drop is forced along the pipe, condenſing the air before it in the ſame degree that it is condenſed in the barrel and receiver.

134 Method of joining together the different pipes, &c.

In conſtructing this pump, Mr Smeaton introduced a method of joining together, the different pipes and other pieces, which has great advantages over the uſual manner of ſcrewing them together with leather between, and which is now much uſed in hydraulic and pneumatic engines. We ſhall explain this to our readers by a deſcription of the manner in which the exhauſting gage is joined to the horizontal duct *cb*.

Plate CCCCI. Plate CCCCII.

The piece *hip*, in fig. 22, n° 2. is the ſame with the little cylinder obſervable on the upper ſide of the horizontal canal *cd*, in fig. 23. The upper part *hi* is formed into an outſide ſcrew, to fit the hollow ſcrew of the piece *deed*. The top of this laſt piece has a hole in its middle, giving an eaſy paſſage to the bent tube *cba*, ſo as to ſlip along it with freedom. To the end of this bent tube is ſoldered a piece of braſs *efg*, perforated in continuation of the tube, and having its end ground flat on the top of the piece *hip*, and alſo covered with a ſlip of thin leather ſtrained acroſs it and pierced with a hole in the middle.

It is plain from this form, that if the ſurface *fg* be applied to the top of *hi*, and the cover *deed* be ſcrewed down on it, it will draw or preſs them together, ſo that no air can eſcape by the joint, and this without turning the whole tube *cba* round, as is neceſſary in the uſual way. This method is now adopted for joining together the conducting pipes of the machines for extinguiſhing fires, an operation which was extremely troubleſome before this improvement.

The conduit pipe E *efc* (fig. 23.) is faſtened to the bottom of the barrel, and the diſcharging pipe *g h* to its top, in the ſame manner. But to return to the gage; the bent pipe *cba* enters the box *st* near one ſide, and obliquely, and the gage pipe *qr* is inſerted through its bottom towards the oppoſite ſide. The uſe of this box is to catch any drops of mercury which may ſometimes be daſhed up through the gage pipe by an accidental oſcillation. This, by going through the paſſages of the pump, would corrode them, and would act particularly on the joints, which are generally ſoldered with tin. When this happens to an air-pump, it muſt be cleaned with the moſt ſcrupulous attention, otherwiſe it will be quickly deſtroyed.

135 Great powers of this pump.

This account of Smeaton's pump is ſufficient for enabling the reader to underſtand its operation and to ſee its ſuperiority. It is reckoned a very fine pump of the ordinary conſtruction, which will rarefy 200 times, or raiſe the gage to 29.85, the barometer ſtanding at 30. But Mr Smeaton found, that his pump, even after long uſing, raiſed it to 29.95, which we conſider as equivalent to rarefying 600 times. When in fine order he found no bounds to its rarefaction, frequently raiſing the gage as high as the barometer, and he thought its performance ſo perfect, that the barometer gage was not ſufficiently delicate for meaſuring the rarefaction. He therefore ſubſtituted the ſyphon gage already deſcribed, which he gives ſome reaſons for preferring; but even this be found not ſufficiently ſenſible.

He contrived another, which could be carried to any

Fig. 18.

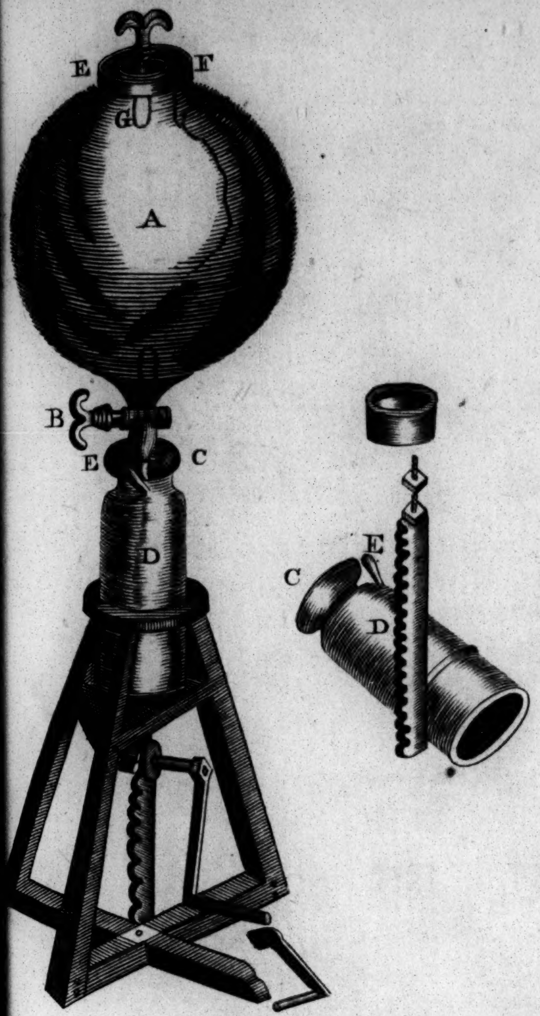
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Fig. 19.

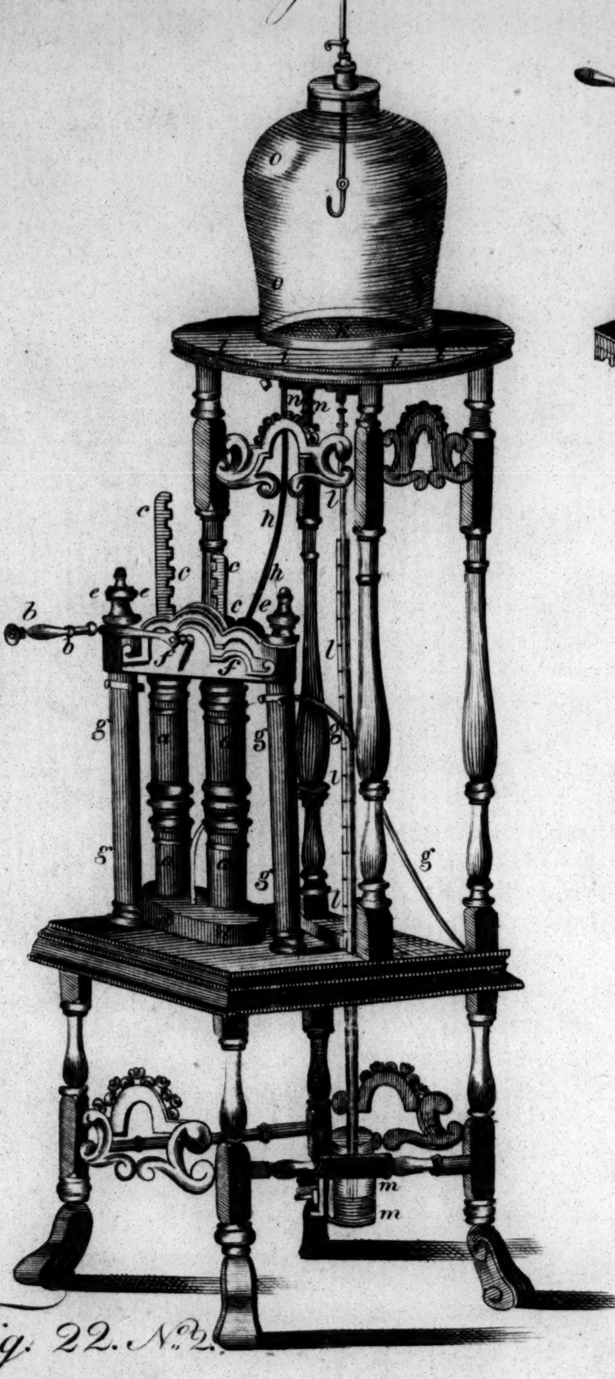
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Fig. 20 N.º 1.

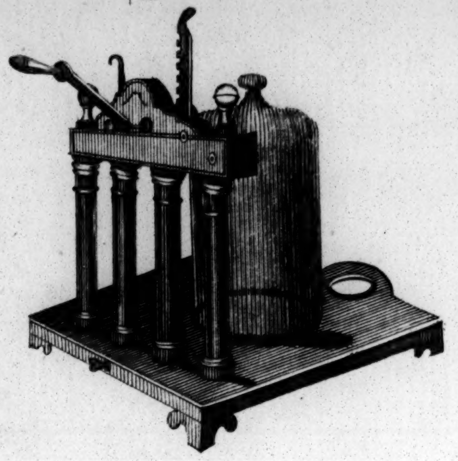

Fig. 20 N.º 2.

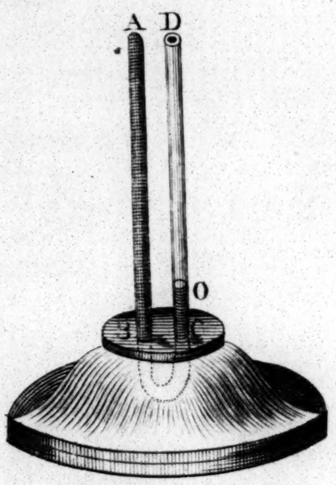

Fig. 21.

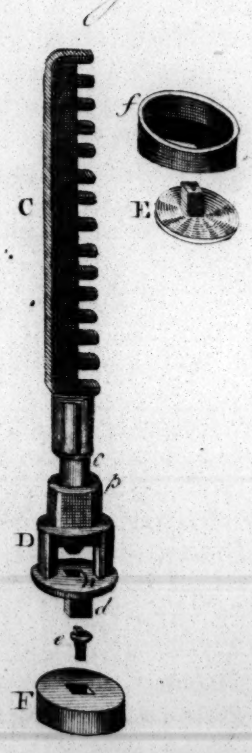

Fig. 22. N.º 1.

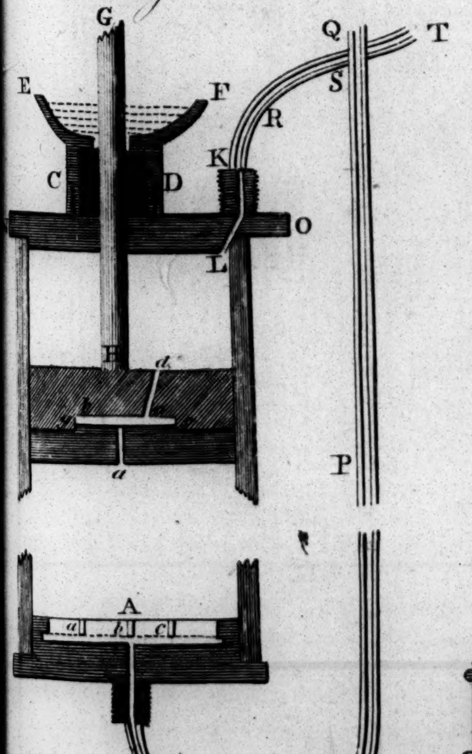
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Fig. 22. N.º 2.

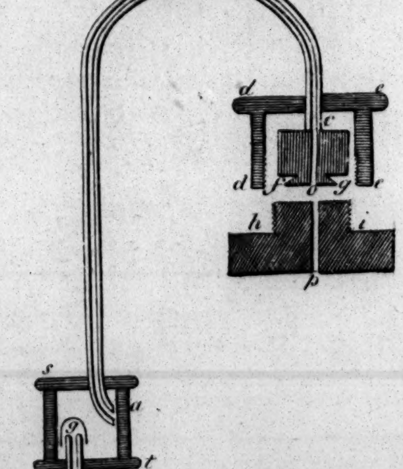
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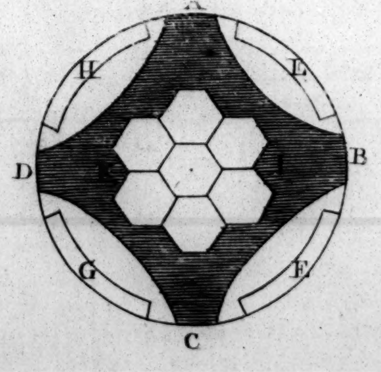
Fig. 22. N.º 3.



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136
Another contrivance of Smeaton's. Plate CCCCII.

any degree of ſenſibility. It conſiſted of a glaſs body A (fig. 24.), of a pear ſhape, and was therefore called the pear-gage. This had a ſmall projecting orifice at B, and at the other end a tube CD, whoſe capacity was the hundredth part of the capacity of the whole veſſel. This was ſuſpended at the ſlip-wire of the receiver, and there was ſet below it a ſmall cup with mercury. When the pump was worked, the air in the pear-gage was rarefied along with the reſt. When the rarefaction was brought to the degree intended, the gage was let down till B reached the bottom of the mercury. The external air being now let in, the mercury was raiſed into the pear, and ſtood at ſome height E in the tube CD. The length of this tube being divided into 100 parts, and thoſe numbered from D, it is evident that $\frac{\mathrm{DE}}{\mathrm{DB}}$ will expreſs the degree of rarefaction which had been produced when the gage was immerſed into the mercury: or if DC be $\frac{1}{100}$ of the whole capacity, and be divided into 100 parts by a ſcale annexed to it, each unit of the ſcale will be $\frac{1}{10000}$ of the whole.

137
Very ingenious.

This was a very ingenious contrivance, and has been the means of making ſome very curious and important diſcoveries which at preſent engage the attention of philoſophers. By this gage Mr Smeaton found, that his pump frequently rarefied a thouſand, ten thouſand, nay an hundred thouſand, times. But though he in every inſtance ſaw the great ſuperiority of his pump above all others, he frequently found irregularities which he could not explain, and a want of correſpondence between the pear and the barometer-gages which puzzled him. The pear-gage frequently indicated a prodigious rarefaction, when the barometer-gage would not ſhow more than 600.

138
It excited the attention of the literary world.

Theſe unaccountable phenomena excited the curioſity of philoſophers, who by this time were making continual uſe of the air-pump in their meteorological reſearches, and much intereſted in every thing connected with the ſtate or conſtitution of elaſtic fluids. Mr Nairne, a moſt ingenious and accurate maker of philoſophical inſtruments, made many curious experiments in the examination and compariſon of Mr Smeaton's pump with thoſe of the uſual conſtruction, attending to every circumſtance which could contribute to the inferiority of the common pumps or to their improvement, ſo as to bring them nearer to this rival machine. This rigorous compariſon brought into view ſeveral circumſtances in the conſtitution of the atmoſpheric air, and its relation to other bodies, which are of the moſt extenſive and important influence in the operations of nature. We ſhall notice at preſent ſuch only as have a relation to the operation of the air-pump in extracting AIR from the receiver.

139
Experiments with it by Mr Nairne.

Mr Nairne found that when a little water, or even a bit of paper damped with water, was expoſed under the receiver of Mr Smeaton's air-pump, when in the moſt perfect condition, raiſing the mercury in the barometer-gage to 29.95, he could not make it riſe above 29.8 if Fahrenheit's thermometer indicated the temperature 47°, nor above 29.7 if the thermometer ſtood at 55°; and that to bring the gage to this height and keep it there, the operation of the pump muſt be continued for a long time after the water had diſappeared or the paper become perfectly dry. He found that a drop of ſpirits, or paper moiſtened with ſpirits, could not in thoſe circumſtances allow the mercury in the gage to riſe to near that height; and that ſimilar effects followed from admitting any volatile body whatever into the receiver or any part of the the apparatus.

140
Show the impropriety of ſoaking the leather with water,

This ſhowed him at once how improper the directions were which had been given by Guericke, Boyle, Graveſande, and others, for fitting up the air-pump for experiment, by ſoaking the leather in water, covering the joints with water, or in ſhort, admitting water or any other volatile body near it.

141
And the utility of uſing olive oil and tallow.

He therefore took his pumps to pieces, cleared them of all the moiſture which he could drive from them by heat, and then leathered them anew with leather ſoaked in a mixture of olive oil and tallow, from which he had expelled all the water it uſually contains, by boiling it till the firſt frothing was over. When the pumps were fitted, up in this manner he uniformly found that Mr Smeaton's pump rarefied the gage to 29.95, and the beſt common pump to 29.87, the firſt of which he computed to indicate a rarefaction to 600, and the other to 230. But in this ſtate he again found that a piece of damp paper, leather, wood, &c. in the receiver, reduced the performance in the ſame manner as before.

142
A remarkable phenomenon.

But the moſt remarkable phenomenon was, that when he made uſe of the pear-gage with the pump cleared from all moiſture, it indicated the ſame degree of rarefaction with the barometer-gage: but when he expoſed a bit of paper moiſtened with ſpirits, and thus reduced the rarefaction of the pump to what he called 50, the barometer-gage ſtanding at 29.4, the pear-gage indicated a rarefaction exceeding 100,000; in ſhort, it was not meaſurable; and this phenomenon was almoſt conſtant. Whenever he expoſed any ſubſtance ſuſceptible of evaporation, he found the rarefaction indicated by the barometer-gage greatly reduced, while that indicated by the pear-gage was prodigiouſly increaſed; and both theſe effects were more remarkable as the ſubject was of eaſier evaporation, or the temperament of the air of the chamber was warmer.

143
Accounted for.

This uniform reſult ſuggeſted the true cauſe. Water boils at the temperature 212, that is, it is then converted into a vapour which is permanently elaſtic while of that temperature, and its elaſticity balances the preſſure of the atmoſphere. If this preſſure be diminiſhed by rarefying the air above it, a lower temperature will now allow it to be converted into elaſtic vapour, and keep it in that ſtate. Water will boil in the receiver of an air-pump at the temperament 96, or even under it. Philoſophers did not think of examining the ſtate of the vapour in temperatures lower than what produced ebullition. But it now appears, that in much lower heats than this the ſuperficial water is converted into elaſtic vapour, which continues to exhale from it as long as the water laſts, and, ſupplying the place of air in the receiver, exerts the ſame elaſticity, and hinders the mercury from riſing in the gage in the ſame manner as ſo much air of equal elaſticity would have done.

144
Experiments illuſtrating this account.

When Mr Nairne was exhibiting theſe experiments to the Honourable Henry Cavendiſh in 1776, this gentleman informed him that it appeared from a ſeries of experiments of his father Lord Charles Cavendiſh, that when water is of the temperature 72, it is converted into vapour, under any preſſure leſs than three-fourths of an inch of mercury, and at 41° it becomes vapour when the preſſure is leſs than one-fourth of an inch:

Even mercury evaporates in this manner when all preſſure is removed. A dewy appearance is frequently obſerved covering the inſide of the tube of a barometer, where we uſually ſuppoſe a vacuum. This dew, when viewed through a microſcope, appears to be a ſet of detached globules of mercury, and upon inclining the tube ſo that the mercury may aſcend along it, theſe globules will be all licked up, and the tube become clear. The dew which lined it was the vapour of the mercury condenſed by the ſide of the tube; and it is never obſerved but when one ſide is expoſed to a ſtream of cold air from a window, &c.

To return to the vapour in the air-pump receiver, it muſt be obſerved, that as long as the water continues to yield it, we may continue to work the pump; and it will be continually abſtracted by the barrels, and diſcharged in the form of water, becauſe it collapſes as ſoon as expoſed to the external preſſure. All this while the gage will not indicate any more rarefaction, becauſe the thing immediately indicated by the barometer-gage is *diminiſhed elaſticity*, which does not happen here. When all the water which the temperature of the room can keep elaſtic has evaporated under a certain preſſure, ſuppoſe ½ an inch of mercury, the gage ſtanding at 29.5, the vapour which now fills the receiver expands, and by its diminiſhed elaſticity the gage riſes, and now ſome more water which had been attached to bodies by chemical or corpuſcular attraction is detached, and a new ſupply continues to ſupport the gage at a greater height; and this goes on continually till *almoſt* all has been abſtracted: but there will remain ſome which no art can take away; for as it paſſes through the barrels, and gets between the piſton and the top, it ſucceſſively collapſes into water during the aſcent of the piſton, and again expands into vapour when we puſh the piſton down again. Whenever this happens there is an end of the rarefaction.

145 Air and vapour not uniformly mixed together.

While this operation is going on, the air comes out along with the vapour; but we cannot ſay in what proportion. If it were always uniformly mixed with the vapour, it would diminiſh rapidly; but this does not appear to be the caſe. There is a certain period of rarefaction in which a tranſient cloudineſs is perceived in the receiver. This is watery vapour formed at that degree of rarefaction, mingled with, but not diſſolved in or united with, the air, otherwiſe it would be tranſparent. A ſimilar cloud will appear if damp air be admitted ſuddenly into an exhauſted receiver. The vapour, which formed an uniform tranſparent maſs with the air, is either ſuddenly expanded and thus detached from the other ingredient, or is ſuddenly let go by the air, which expands more than it does. We cannot affirm with probability which of theſe is the caſe: different compoſitions of air, that is, air loaded with vapours from different ſubſtances, exhibit remarkable differences in this reſpect. But we ſee from this and other phenomena, which ſhall be mentioned in their proper places, that the air and vapour are not always intimately united; and therefore will not always be drawn out together by the air-pump. But let them be ever ſo confuſedly blended we ſee that the air muſt come out along with the vapour, and its quantity remaining in the receiver muſt be prodigiouſly diminiſhed by this aſſociation, probably much more than could be, had the receiver only contained pure air.

146 Conſequences of this difference in the pear and barometer gages.

Let us now conſider what muſt happen in the pear-gage. As the air and vapour are continually drawn off from the receiver, the air in the pear expands and goes off with it. We ſhall ſuppoſe that the generated vapour hinders the gage from riſing beyond 29.5. During the continued working of the pump, the air in the pear, whoſe elaſticity is 0.5, ſlowly mixes with the vapour at the mouth of the pear, and the mixture even advances into its inſide, ſo that if the pumping be long enough continued, what is in the pear is nearly of the ſame compoſition with what is in the receiver, conſiſting perhaps of 20 parts of vapour and one part of air, all of the elaſticity of 0.5. When the pear is plunged into the mercury, and the external air allowed to get into the receiver, the mercury riſes in the pear-gage, and leaves not $\frac{1}{60}$, but $\frac{1}{60\times 20}$ or $\frac{1}{1200}$ of it filled with common air, the vapour having collapſed into an inviſible atom of water. Thus the pear gage will indicate a rarefaction of 1200, while the barometer-gage only ſhowed 60, that is, ſhowed the elaſticity of the included ſubſtance diminiſhed 60 times. The concluſion to be drawn from theſe two meaſures (the one of the rarefaction of air, and the other of the diminution of elaſticity) is, that the matter with which the receiver was filled, immediately before the readmiſſion of the air, conſiſted of one part of incondenſible air, and $\frac{1200}{60}$, or 20 parts of watery vapour.

147 Difficulty in accounting for ſome of theſe conſequences.

The only obſcure part of this account is what relates to the compoſition of the matter which filled the pear-gage before the admiſſion of the mercury. It is not eaſy to ſee how the vapour of the receiver comes in by a narrow mouth while the air is coming out by the ſame paſſage. Accordingly it requires a *very long time* to produce this extreme rarefaction in the pear-gage; and there are great irregularities in any two ſucceeding experiments, as may be ſeen by looking at Mr Nairne's account of them in Philoſophical Tranſactions, Vol. LXVII. Some vapours appear to have mixed much more readily with the air than others; and there are ſome unaccountable caſes where vitriolic acid and ſulphureous bodies were included, in which the diminution of denſity indicated by the pear-gage was uniformly leſs than the diminution of elaſticity indicated by the barometer-gage. It is enough for us at preſent to have eſtabliſhed, by unqueſtionable facts, this production of elaſtic vapour, and the neceſſity of attending to it, both in the conſtruction of the air-pump and in drawing reſults from experiments exhibited in it.

148 The ſuperiority of this pump excites to new improvements.

Mr Smeaton's pump, when in good order, and perfectly free from all moiſture, will in dry weather rarefy air about 600 times, raiſing the barometer gage to within $\frac{1}{20}$ of an inch of a fine barometer. This was a performance ſo much ſuperior to that of all others, and by means of Mr Nairne's experiments opened ſo new a field of obſervation, that the air-pump once more became a capital inſtrument among the experimental philoſophers. The cauſes of its ſuperiority were alſo ſo diſtinct, that artiſts were immediately excited to a farther improvement of the machine; ſo that this becomes a new epoch in its hiſtory.

This is one imperfection which Mr Smeaton has not attempted to remove. The diſcharging valve is ſtill opened ed againſt the preſſure of the atmoſphere. An author of the Swediſh academy adds a ſubſidiary pump to this valve, which exhauſts the air from above it, and thus puts it in the ſituation of the piſton valve. We do not find that this improvement has been adopted ſo as to become general. Indeed the quantity of air which remains in the paſſage of this valve is ſo exceedingly little, that it does not ſeem to merit attention. Suppoſing the valve-hole $\frac{1}{10}$ of an inch wide and as deep (and it need not be more), it will not occupy more than $\frac{1}{9700}$ part of a barrel twelve inches long and two inches wide.

149 Improvements in this pump attempted.

150 Mr Smeaton, by his ingenious conſtruction, has greatly diminiſhed, but has not annihilated, the obſtructions to the paſſage of the air from the receiver into the barrel. His ſucceſs encouraged farther attempts. One of the firſt and moſt ingenious was that of Profeſſor Ruſſel of the univerſity of Edinburgh, who about the year 1770 conſtructed a pump in which both cocks and valves were avoided.

151 By Ruſſel,

The piſton is ſolid, as repreſented in fig. 25. and its rod paſſes through a collar of leather on the top of the barrel. This collar is divided into three portions by two braſs rings *a*, *b*, which leave a very ſmall ſpace round the piſton rod. The upper ring *a* communicates by means of a lateral perforation with the bent tube *l m n*, which enters the barrel at its middle *n*. The lower ring *b* communicates with the bent tube *c d*, which communicates with the horizontal paſſage *d e*, going to the middle *e*, of the pump plate. By the way, however, it communicates alſo with a barometer gage *p o*, ſtanding in a ciſtern of mercury *o*, and covered with a glaſs tube cloſe at the top. Beyond *e*, on the oppoſite circumference of the receiver plate, their is a cock or plug *f* communicating with the atmoſphere.

The piſton rod is cloſely embraced by the three collars of leather; but, as already ſaid, has a free ſpace round it in the two braſs rings. To produce this preſſure of the leathers to the rod, the braſs rings which ſeparate them are turned thinner on the inner ſide, ſo that their croſs ſection along a diameter would be a taper wedge. In the ſide of the piſton rod are two cavities *q r*, *t s*, about one-tenth of an inch wide and deep, and of a length equal to the thickneſs of the two rings *a*, *b*, and the intermediate collar of leathers. Theſe cavities are ſo placed on the piſton-rod, that when the piſton is applied to the bottom of the barrel, the cavity *t s* in the upper end of the rod has its upper end oppoſite to the ring *a*, and its lower end oppoſite to the ring *b*, or to the mouth of the pipe *c d*. Therefore, if there be a void in the barrel, the air from the receiver will come from the pipe *c d* into the cavity in the piſton rod, and by it will get paſt the collar of leather between the rings, and thus will get into the ſmall interſtice between the rod and the upper ring, and then into the pipe *l m n*, and into the empty barrel. When the piſton is drawn up, the ſolid rod immediately ſhuts up this paſſage, and the piſton drives the air through the diſcharging valve *k*. When it has reached the top of the barrel, and is cloſely applied to it, the cavity *q r* is in the ſituation in which *t s* formerly was, and the communication is again opened between the receiver and the empty barrel, and the air is again diffuſed between them. Puſhing down the piſton expels the air by the lower diſcharging pipe and valve *h i*; and thus the operation may be continued.

This muſt be acknowledged to be a moſt ſimple and ingenious conſtruction, and can neither be called a cock nor a valve. It ſeems to oppoſe no obſtruction whatever: and it has the ſuperior advantage of rarefying both during the aſcent and the deſcent of the piſton, doubling the expedition of the performance, and the operator is not oppoſed by the preſſure of the atmoſphere except towards the end of each ſtroke. The expedition, however, is not ſo great as one ſhould expect; for nothing is going on while the piſton is in motion, and the operator muſt ſtop a while at the end of each ſtroke, that the air may have time to come through this long, narrow, and crooked paſſage, to fill the barrel. But the chief difficulty which occurred in the execution aroſe from the clammy oil with which it was neceſſary to impregnate the collar of leathers. Theſe were always in a ſtate of ſtrong compreſſion, that they might cloſely graſp the piſton rod, and prevent all paſſage of air during the motion of the piſton. Whenever therefore the cavities in the piſton rod come into the ſituations neceſſary for connecting the receiver and barrel, this oil is ſqueezed into them, and choaks them up. Hence it always happened that it was ſome time after the ſtroke before the air could force its way round the piſton rod, carrying with it the clammy oil which choaked up the tube *l m n*; and when the rarefaction had proceeded a certain length, the diminiſhed elaſticity of the air was not able to make its way through theſe obſtructions. The death of the ingenious author put a ſtop to the improvements by which he hoped to remedy this defect, and we have not heard that any other perſon has ſince attempted it. We have inſerted it here, becauſe its principle of conſtruction is not only very ingenious, but entirely different from all others, and may furniſh very uſeful hints to thoſe who are much engaged in the conſtruction of pneumatic engines.

152 By Haas and Hurter,

In the 73d volume of the Philoſophical Tranſactions, Mr Tiberius Cavallo has given the deſcription of an air-pump contrived and executed by Meſſrs Haas and Hurter, inſtrument-makers in London, where theſe artiſts have received Guericke's method of opening the barrel-valve during the laſt ſtrokes of the pump by a force acting from without. We ſhall inſert ſo much of this deſcription as relates to this diſtinguiſhing circumſtance of its conſtruction.

Fig. 26. repreſents a ſection of the bottom of the barrel, where AA, is the barrel and BB the bottom, which has in its middle a hollow cylinder CCFF, projecting about half an inch into the barrel at CC, and extending a good way downwards to FF. The ſpace between this projection and the ſides of the barrel is filled up by a braſs ring DD, over the top of which is ſtrained a piece of oiled ſilk EE, which performs the office of a valve, covering the hole CC. But this hole is filled up by a piece of braſs, or rather an aſſemblage of pieces ſcrewed together GGHHII. It conſiſts of three projecting fillets or ſhoulders GG, HH, II, which form two hollows between them, and which are filled with rings of oiled leather OO, PP, firmly ſcrewed together. The extreme fillets GG, II, are of equal diameter with the inſide of the cylinder, ſo as to fill it exactly, and the whole ſtuffed with oiled leather, ſlide up and down without allowing any air to paſs. The middle fillet HH is not ſo broad, but thicker. In the upper fillet GG there is formed a ſhallow diſh about $\frac{1}{8}$ of an inch deep and ¾ wide. This diſh is covered with a thin plate, pierced with a grating like Mr Smeaton's valve-plate. There is a perforation VX along the axis of this piece, which has a paſſage out at one ſide H, through the middle fillet. Oppoſite to this paſſage, and in the ſide of the cylinder CCFF, is a hole M, communicating with the conduit pipe MN, which leads to the receiver. Into the lower end of the perforation is ſcrewed the pin KL, whoſe tail L paſſes through the cap FF. The tail L is connected with a lever RQ, moveable round the joint Q. This lever is puſhed upwards by a ſpring, and thus the whole piece which we have been deſcribing is kept in contact with the ſlip of oiled ſilk or valve EE. This is the uſual ſituation of things.

153 Now ſuppoſe a void formed in the barrel by drawing up the piſton; the elaſticity of the air in the receiver, in the pipe NM, and in the paſſage XV, will preſs on the great ſurface of the valve expoſed through the grating, will raiſe it, and the pump will perform preciſely as Mr Smeaton's does. But ſuppoſe the rarefaction to have been ſo long continued, that the air is no longer able to raiſe the valve; this will be ſeen by the mercury riſing no more in the pump-gage. When this is perceived, the operator muſt preſs with his foot on the end R of the lever RQ. This draws down the pin KL, and with it the whole hollow plug with its grated top. And thus, inſtead of raiſing the valve from its plate, the plate is here drawn down from the valve. The air now gets in without any obſtruction whatever, and the rarefaction proceeds as long as the piſton riſes. When it is at the top of the barrel, the operator takes his foot from the lever, and the ſpring preſſes up the plug again and ſhuts the valve. The piſton rod paſſes through a collar of leather, as in Mr Smeaton's pump, and the air is finally diſcharged through an outward valve in the top of the barrel. Theſe parts have nothing peculiar in them.

This is an ingenious contrivance, ſimilar to what was adapted by Guericke himſelf; and we have no doubt of theſe pumps performing extremely well if carefully made: and it ſeems not difficult to keep the plug perfectly air-tight by ſupplying plenty of oil to the leathers. We cannot ſay, however, with preciſion what may be expected from it, as no account had been given of its effects beſides what Mr Cavallo publiſhed in Philoſophical Tranſactions 1783, where he only ſays, that when it had been long uſed, it had, in the courſe of ſome experiments rarefied 600 times.

154 By Prince. Aiming ſtill at the removing the obſtructions to the entry of the air from the receiver into the barrels, Mr Prince, an American, has conſtructed a pump in which there is no valve or cock whatever between them. In this pump the piſton rod paſſes through a collar of leathers, and the air is finally diſcharged through a valve, as in the two laſt. But we are chiefly to attend, in this place, to the communication between the barrel and the receiver. The barrel widens below into a ſort of ciſtern ABCD (fig. 27.), communicating with the receiver by the pipe EF. As ſoon, therefore, as the piſton gets into this wider part, where there is a vacancy all round it, the air of the receiver expands freely through the paſſage FEE into the barrel, in which the deſcent of the piſton had made a void. When the piſton is again drawn up, as ſoon as it gets into the cylindric part of the barrel, which it exactly fills, it carries up the air before it, and expels it by the top valve; and, that this may be done more completely, this valve opens into a ſecond barrel or air-pump whoſe piſton is riſing at the ſame time, and therefore the valve of communication (which is the diſcharging valve of the primary pump) opens with the ſame facility as Mr Smeaton's piſton valve. While the piſton is riſing, the air in the receiver expands into the barrel; and when the piſton deſcends, the air in the barrel again collapſes till the piſton gets again into the ciſtern, when the air paſſes out, and fills the evacuated barrel, to be expelled by the piſton as before. Plate CCCCII.

No diſtinct account has as yet been given of the performance of this pump. We only learn that great inconveniences were experienced from the oſcillations of the mercury in the gage. As ſoon as the piſton comes into the ciſtern, the air from the receiver immediately ruſhes into the barrel and the mercury ſhoots up in the gage, and gets into a ſtate of oſcillation. The ſubſequent riſe of the piſton will frequently keep time with the ſecond oſcillation, and increaſe it. The deſcent of the piſton produces a downward oſcillation, by allowing the air below it to collapſe; and, by improperly timing the ſtrokes, this oſcillation becomes ſo great as to make the mercury enter the pump. To prevent this, and a greater irregularity of working as a condenſer, valves were put in the piſton: but as theſe require force to open them, the additon ſeemed rather to increaſe the evil, by rendering the oſcillations more ſimultaneous with the ordinary rate of working. If this could be got over, the conſtruction ſeems very promiſing.

It appears, however, of very difficult execution. It has many long, ſlender, and crooked paſſages, which muſt be drilled through broad plates of braſs, ſome of them appearing ſcarcely practicable. It is rare to find plates and other pieces of braſs without air-holes, which it would be very difficult to find out and to cloſe; and it muſt be very difficult to clear it of obſtructions: ſo that it appears rather a ſuggeſtion of theory than a thing warranted by its actual performance.

155 By Lavoiſier, Mr Lavoiſier, or ſome of the naturaliſts who were occupied in concert with him in the inveſtigation of the different ſpecies of gas which are diſengaged from bodies in the courſe of chemical operations, has contrived an air-pump which has great appearance of ſimplicity, and, being very different from all others, deſerves to be taken notice of.

It conſiſts of two barrels *l*, *m*, fig. 28, with ſolid piſtons *k k*. The pump-plate *a b* is pierced at its centre *c* with a hole which branches towards each of the barrels, as repreſented by *c d*, *c e*. Between the plate and the barrels ſlides another plate *hi*, pierced in the middle with a branched hole *f d g*, and near the ends with two holes *h h*, *i i*, which go from its underſide to the ends. The holes in theſe two plates are ſo adjuſted, that when the plate *h i* is drawn ſo far towards *h* that the hole *i* comes within the barrel *m*, the branch *d f* of the hole in the middle plate coincides with the branch *c d* of the upper plate, and the holes *e*, *g* are ſhut. Thus a communication is eſtabliſhed between the barrel *l* and the receiver on the pump-plate, and between the barrel *m* and the external air. In this ſituation the barrel *l* will exhauſt, and *m* will diſcharge. When the piſton of *l* is at its mouth, and that of *m* touches its bottom, the ſliding plate is ſhifted over to the other ſide, ſo that *m* com-

PNEUMATICS Plate CCCCII.

Fig. 23.

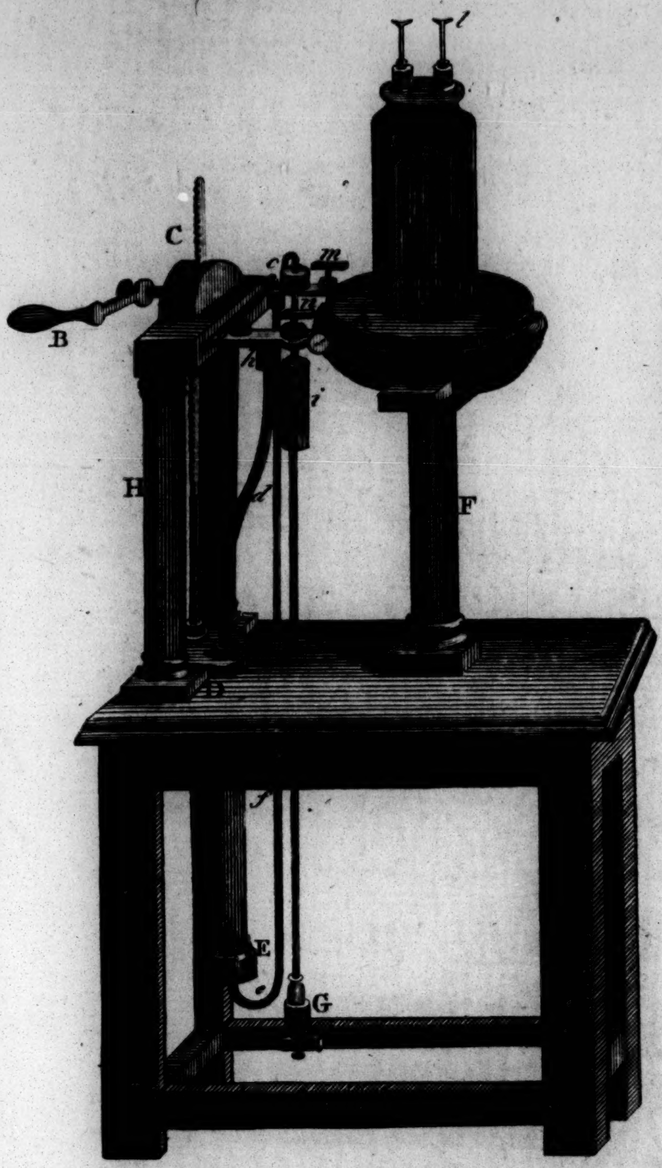
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Fig. 24.

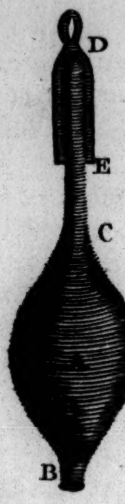

Fig. 30.

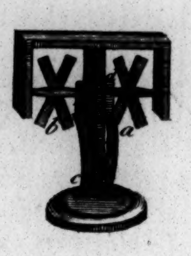

Fig. 31.

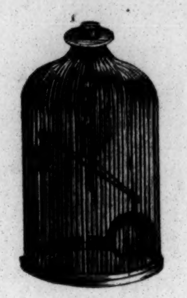

Fig. 27.

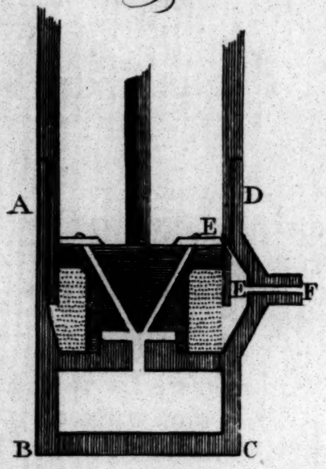

Fig. 29.

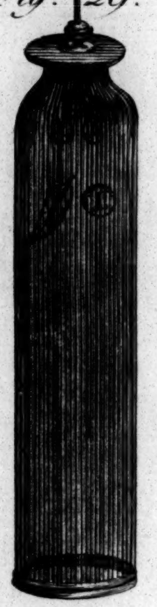

Fig. 28.

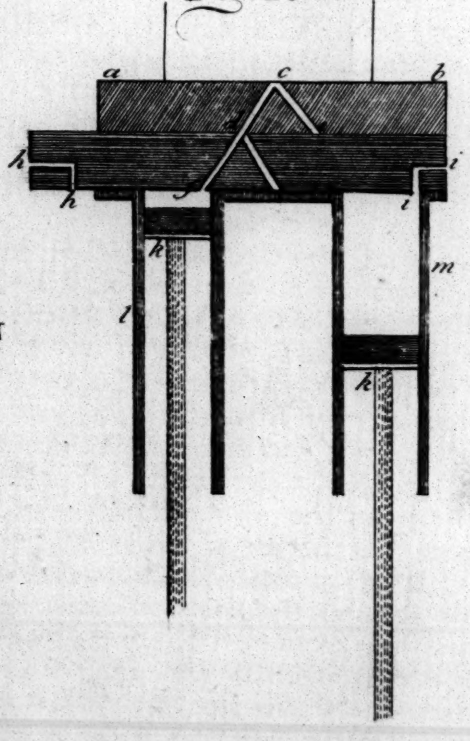
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Fig. 25.

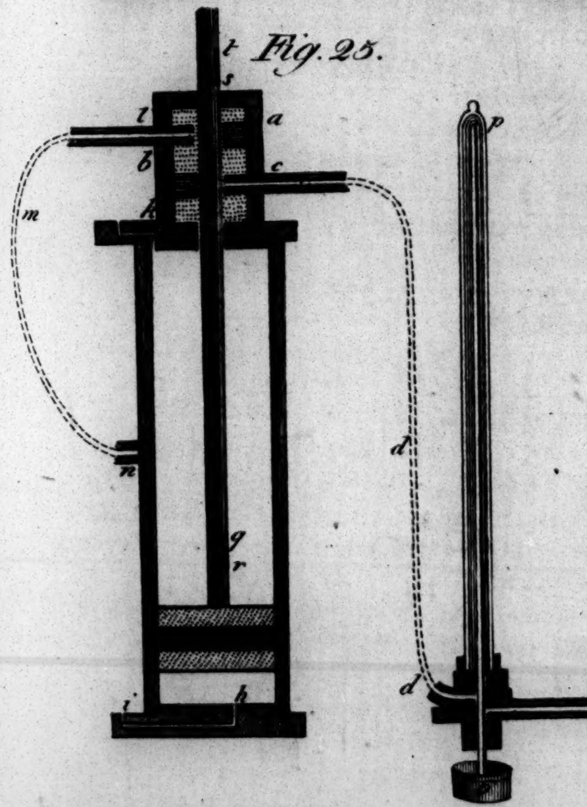
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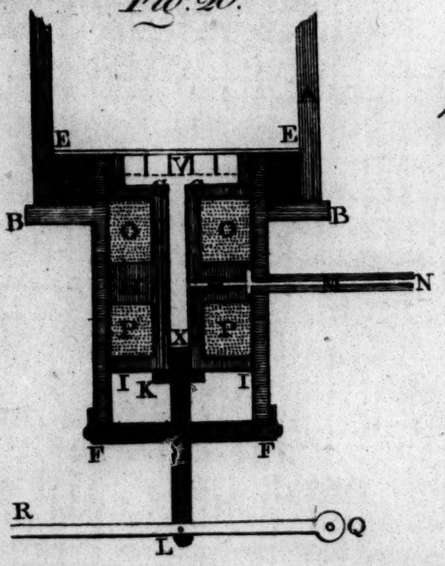
Fig. 26.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Scot & Allardice.

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m communicates with the receiver through the paſſage *gd*, *ec*, and *l* communicates with the air by the paſſages *h h*.

It is evident that this ſliding plate performs the office of four cocks in a very beautiful and ſimple manner, and that if the piſtons apply cloſe to the ends of the barrels, ſo as to expel the whole air, the pump will be perfect. It works, indeed, againſt the whole preſſure of the external air. But this may be avoided by putting valves on the holes *h*, *i*; and theſe can do no harm, becauſe the air remaining in them never gets back into the barrel till the piſton be at the farther end, and the exhauſtion of that ſtroke completed. But the beſt workmen of London think that it will be incomparably more difficult to execute this cock (for it is a cock of an unuſual form), in ſuch a manner that it ſhall be air-tight and yet move with tolerable eaſe, and that it is much more liable to wearing looſe than common cocks. No accurate accounts have been received of its performance. It muſt be acknowledged to be ingenious, and it may ſuggeſt to an intelligent artiſt a method of combining common conical cocks upon one axis ſo as to anſwer the ſame purpoſes much more effectually; for which reaſon we have inſerted it here.

156 And by Cuthbertſon.

The laſt improvement which we ſhall mention is that publiſhed by Mr Cuthbertſon philoſophical inſtrument-maker in Amſterdam. His pump has given ſuch evidences of its perfection, that we can hardly expect or wiſh for any thing more complete. But we muſt be allowed to obſerve, beforehand, that the ſame conſtruction was invented, and, in part, executed before the end of 1779, by Dr Daniel Rutherford, now profeſſor of botany in the univerſity of Edinburgh, who was at that time engaged in experiments on the production of air during the combuſtion of bodies in contact with nitre, and who was vaſtly deſirous of procuring a more complete abſtraction of pure aerial matter than could be effected by Mr Smeaton's pump. The compiler of this article had then an opportunity of peruſing the Doctor's diſſertation on this ſubject, which was read in the Philoſophical Society of Edinburgh. In this diſſertation the Doctor appears fully appriſed of the exiſtence of pure vital air in the nitrous acid as its chief ingredient, and as the cauſe of its moſt remarkable phenomena, and to want but a ſtep to the diſcoveries which have ennobled the name of Mr Lavoiſier. He was particularly anxious to obtain *apart* this diſtinguiſhing ingredient in its compoſition, and, for this purpoſe, to abſtract completely from the veſſel in which he ſubjected it to examination, every particle of elaſtic matter. The writer of this article propoſed to him to cover the bottom of Mr Smeaton's piſton with ſome clammy matter, which ſhould take hold of the bottom valve, and *ſtart it* when the piſton was drawn up. A few days after, the Doctor ſhowed him a drawing of a pump, having a conical metal valve in the bottom, furniſhed with a long ſlender wire, ſliding in the inſide of the piſton rod with a gentle friction, ſufficient for lifting the valve, and ſecured againſt all chance of ſailure by a ſpring a top, which took hold of a notch in the inſide of the piſton-rod about a quarter of an inch from the lower end, ſo as certainly to lift the valve during the laſt quarter of an inch of the piſton's motion. Being an excellent mechanic, he had executed a valve on this principle, and was fully ſatisfied with its performance. But having already confirmed his doctrines reſpecting the nitrous acid by incontrovertible experiments, his wiſhes to improve the air-pump loſt their incitement, and he thought no more of it; and not long after this, the ardour of the philoſophers of the Teylerian Society at Haerlem and Amſterdam excited the efforts of Mr Cuthbertſon, their inſtrument-maker, to the ſame purpoſe, and produced the moſt perfect air-pump that has yet appeared. We ſhall give a deſcription of it, and an account of its performance, in the inventor's own words.

CUTHBERTSONS's *Air-pump*.

157 Plate CCCCVIII. is a perſpective view of this pump, with its two principal gages ſcrewed into their places. Theſe need not be uſed together, except in caſes where the utmoſt exactneſs is required. In common experiments one of them is removed, and a ſtop-ſcrew put in its place. When the pear-gage is uſed, a ſmall round plate, on which the receiver may ſtand, muſt be firſt ſcrewed into the hole at A; but this hole is ſtopped on other occaſions with a ſcrew. When all the three gages are uſed, and the receiver is exhauſted, the ſtop-ſcrew B, at the bottom of the pump, muſt be unſcrewed, to admit the air into the receiver; but when they are not all uſed, either of the other ſtop-ſcrews will anſwer this purpoſe.

Fig. 2. repreſents a croſs-bar for preventing the barrels from being ſhaken by working the pump or by any accident. Its place in fig. 1. is repreſented by the dotted lines. It is confined in its place, and kept cloſe down on the barrels by two ſlips of wood NN, which muſt be drawn out, as well as the ſcrews OO, when the pump is to be taken aſunder.

Plate CCCCIX. is a ſection of all the working parts of the pump, except the wheel and rack, in which there is nothing uncommon.

Fg. 1. is a ſection of one of the barrels, with all its internal parts; and fig. 2, 3, 4, and 5, are different parts of the piſton, proportioned to the ſize of the barrel (A) and to one another.

In fig. 1. CD repreſents the barrel, F the collar of leathers, G a hollow cylindrical veſſel to contain oil, R is alſo an oil-veſſel to receive the oil which is drawn, along with the air, through the hole *a a*, when the piſton is drawn upwards; and, when this is full, the oil is carried over with the air, along the tube T, into the oil-veſſel G. *c c* is a wire which is driven upwards from the hole *a a* by the paſſage of the air; and as ſoon as this has eſcaped, it falls down again by its own weight, ſhuts up the hole, and prevents all return of the air into the barrel. At *d d* are fixed two pieces of braſs, to keep the wire *c c* in a vertical direction, that it may accurately ſhut the hole. H is a cylindrical

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(A) The piſton and barrel are 1,65 inches in diameter, in proportion to which the ſcale is drawn. Figures 2, 3, 4, 5. are, however, of double ſize.

Plate CCCCIX.

cal wire or rod which carries the piſton I, and is made hollow to receive a long wire *gg*, which opens and ſhuts the hole L; and on the other end of the wire O is ſcrewed a nut, which, by ſtopping in the narroweſt part of the hole, prevents the wire from being driven up too far. This wire and ſcrew are more clearly ſeen in fig. 2. and 6; they ſlide in a collar of leather *r r*, fig. 2. and 5. in the middle piece of the piſton. Fig. 4. and 5. are the two mean parts which compoſe the piſton, and, when the pieces 3. and 6. are added to it, the whole is repreſented by fig. 2. Fig. 5. is a piece of braſs of a conical form, with a ſhoulder at the bottom. A long hollow ſcrew is cut in it, about ⅔ of its length, and the remainder of the hole, in which there is no ſcrew, is of about the ſame diameter with the ſcrewed part, except a thin plate at the end, which is of a width exactly equal to the thickneſs of *g g*. That part of the inſide of the conical braſs in which no thread is cut, is filled with oiled leathers with holes through which *g g* can ſlide ſtiffly. There is alſo a male ſcrew with a hole in it, fitted to *gg*, ſerving to compreſs the leathers *rr*. In fig. 4. *aaaa* is the outſide of the piſton, the inſide of which is turned ſo as exactly to fit the outſide of fig. 5. *bb* are round leathers about 60 in number, *cc* is a circular piece of braſs of the ſize of the leathers, and *d d* is a ſcrew ſerving to compreſs them. The ſcrew at the end of fig. 3. is made to fit the ſcrew in fig. 5. Now if fig. 6. be puſhed into fig. 5, this into fig. 4, and fig. 3. be ſcrewed into the end of fig. 5, theſe will compoſe the whole of the piſton, as repreſented in fig. 2. H in fig. 1. repreſents the ſame part as H in fig. 2, and is that to which the rack is fixed. If, therefore, this be drawn upwards, it will cauſe fig. 5. to ſhut cloſe into fig. 4, and drive out the air above it; and when it is puſhed downward, it will open as far as the ſhoulder *aa* will permit and ſuffer air to paſs through. AA fig. 7. is the receiver plate, BB is a long ſquare piece of braſs, ſcrewed into the under ſide of the plate, through which a hole is drilled correſponding to that in the centre of the receiver-plates and with three female ſcrews *b*, *b*, *c*.

The rarefaction of the air in the receiver is effected as follows. Suppoſe the piſton at the bottom of the barrel. The inſide of the barrel, from the top of the piſton to *a*, contains common air. When the rod is drawn up, the upper part of the piſton ſticks faſt in the barrel till the conical part connected with the rod ſhuts the conical hole, and its ſhoulder applies cloſe to its bottom. The piſton is now ſhut, and therefore the *whole* is drawn up by the rack-work, driving the air before it through the hole *aa*, into the oil-veſſel at R, and out into the room by the tube T. The piſton will then be at the top of the barrel at *a*, and the wire *gg* will ſtand nearly as repreſented in the figure juſt raiſed from the hole L, and prevented from riſing higher by the nut O. During this motion the air will expand in the receiver, and come along the bent tube *m* into the barrel. Thus the barrel will be filled with air, which, as the piſton riſes, will be rarefied in proportion as the capacity of the receiver, pipes, and barrel is to the barrel alone. When the piſton is moved down again by the rack-work, it will force the conical part fig. 5, out of the hollow part fig. 4. as far as the ſhoulders *aa*; fig. 2. will reſt on *aa* fig. 4, which will then be ſo far open as to permit the air to paſs freely through it, while at the ſame time the end of *gg* is forced againſt the top of the hole, and ſhuts it in order to prevent any air from returning into the receiver. Thus the piſton, moving downwards, ſuffers the air to paſs out between the ſides of fig. 4. and 5.; and, when it is at the bottom of the barrel, will have the column of air above it; and, conſequently, when drawn upwards it will ſhut, and drive out this air, and, by opening the hole L at the ſame time, will give a free paſſage to more air from the receiver. This proceſs being continued, the air of the receiver will be rarefied *as far as its expanſive power will permit*. For in this machine there are no valves to be forced open by the elaſticity of the air in the receiver, which at laſt it is unable to effect. There is therefore nothing to prevent the air from expanding to its utmoſt degree.

It may be ſuſpected here, that as the air muſt eſcape through the diſcharging paſſage *ac*, Plate CCCCIX. fig. 1. againſt the preſſure of a column of oil and the weight of the wire, there will remain in this paſſage a quantity of air of conſiderable denſity, which will expand again into the barrel during the deſcent of the piſton, and thus put a ſtop to the progreſs of rarefaction. This is the caſe in Mr Smeaton's pump, and all which have valves in the piſton. But it is the peculiar excellency of this pump, that whatever be the denſity of the air remaining in *a c*, the rarefaction will ſtill go on. It is worth while to be perfectly convinced of this. Let us ſuppoſe that the air contained in *ac* is $\frac{1}{10}$ part of the common air which would fill the barrel, and that the capacity of the barrel is equal to that of the receiver and paſſages, and that the air in the receiver and barrel is of the ſame denſity, the piſton being at the bottom of the barrel: The barrel will therefore contain $\frac{10}{1000}$ parts of its natural quantity, and the receiver $\frac{10}{1000}$. Now let the piſton be drawn up. No air will be diſcharged at *a c*, becauſe it will contain the whole air which was in the barrel, and which has now collapſed into its ordinary bulk. But this does not in the leaſt hinder the air of the receiver from expanding into the barrel, and diffuſing itſelf equally between both. Each will now contain $\frac{5}{1000}$ of their ordinary quantity when the piſton is at the top, and *a c* will contain $\frac{1}{10}$ as before, or $\frac{100}{1000}$. Now puſh down the piſton. The hole L is inſtantly ſhut, and the air in *a c* expands into the barrel, and the barrel now contains $\frac{15}{1000}$. When the piſton has reached the bottom, let it be again drawn up. There wille be $\frac{5}{1000}$ diſcharged through *c*, and the air in the receiver will again be equally diſtributed between it and the barrel. Therefore the receiver will now contain $\frac{2\frac{1}{2}}{1000}$. When the piſton reaches the bottom, there will be $\frac{12\frac{1}{2}}{1000}$ in the barrel. When again drawn up to the top, there will be $\frac{2\frac{1}{2}}{1000}$ diſcharged, and the receiver will contoin $\frac{1\frac{1}{4}}{100}$; and when the piſton reaches the bottom, there will be $\frac{11\frac{1}{4}}{1000}$. At the next ſtroke the receiver will contain only $\frac{0.\frac{5}{8}}{1000}$, &c. &c.

Thus it appears, that notwithſtanding the $\frac{100}{1000}$ which always expands back again out of the hole *a c* into the barrel, the rarity of the air in the receiver will be doubled at every ſtroke. There is therefore no need of a ſubſidiary air-pump at *c*, as in the American air-pump, and in the Swediſh attempt to improve Smeaton's.

In uſing this air-pump no particular directions are neceſſary, nor is any peculiar care neceſſary for keeping it in order, except that the oil-veſſel A be always kept about half full of oil. When the pump has ſtood long without being uſed, it will be proper to draw a table-ſpoonful of olive-oil through it, by pouring it into the hole in the middle of the receiver-plate when the piſton is at the bottom of the barrel. Then by working the piſton, the oil will be drawn through all the parts of the pump, and the ſurplus will be driven through the tube T into the oil-veſſel G. Near the top of the piſton-rod at H there is a hole which lets ſome oil into the inſide of the rod, which gets at the collar of leathers *r r*, and keeps the wire *g g* air-right.

Plate CCCCIX.

When the pump is uſed for condenſation at the ſame time that it rarefies, or ſeparately, the piece containing the bent tube T muſt be removed, and fig. 8. put into its place, and fixed by its ſcrews. Fig. 8. as drawn in the plate, is intended for a double barreled pump. But for a ſingle barrel only one piece is uſed, repreſented by *b a a*, the double piece being cut off at the dotted line *a a*. In this piece is a female ſcrew to receive the end of a long braſs tube, to which a bladder (if ſufficient for the experiment of condenſation), or a glaſs, properly ſecured for this purpoſe, muſt be ſcrewed. Then the air which is abſtracted from the receiver on the pump-plate will be forced into the bladder or glaſs. But if the pump be double, the apparatus fig 8. is uſed, and the long braſs tube ſcrewed on at *c*.

Fig. 9. and 10. repreſent the two gages, which will be ſufficiently explained afterwards. Fig. 9. is ſcrewed into *c b*, or into the ſcrew at the other end of *c* fig 7. and fig. 10. into the ſcrew *a b* fig. 7.

If it be uſed as a ſingle pump, either to rarefy or condenſe, the ſcrew K, which faſtens the rack to the piſton-rod H, muſt be taken out. Then turning the winch till H is depreſſed as low as poſſible, the machine will be fitted to exhauſt as a ſingle pump; and if it be required to condenſe, the direction in nº 8. muſt be obſerved with regard to the tube T, and fig. 8.

"I took (ſays Mr Cuthbertſon) two barometer-tubes of an equal bore with that fixed to the pump. Theſe were filled with mercury four times boiled. They were then compared, and ſtood exactly at the ſame height. The mercury in one of them was boiled in it four times more, without making any change in their height; they were therefore judged very perfect. One of theſe was immerſed in the ciſtern of the pump-gage, and faſtened in a poſition parallel to it, and a ſliding ſcale of one inch was attached to it. This ſcale, when the gage is uſed, muſt have its upper edge ſet equal with the ſurface of the mercury in the boiled tube after exhauſtion, and the difference between the height of the mercury in this and in the other barometer tube may be obſerved to the $\frac{1}{100}$ of an inch; and being cloſe together, no error ariſes from their not being exactly vertical, if they are only parallel. This gage will be better underſtood by inſpecting fig. 10.

"I uſed a ſecond gage, which I ſhall call a double ſyphon. See Plate CCCCIX. fig. 9. This was alſo prepared with the utmoſt care. I had a ſcale for meaſuring the difference between the height of the columns in the two legs. It was an inch long, and divided as the former, and kept in a truly vertical poſition by ſuſpending it from a point with a weight hung to it, as repreſented in the figure. Upon comparing theſe two gages, I always found them to indicate the ſame degree of rarefaction. I alſo uſed a pear-gage, though the moſt imperfect of all, in order to repeat the curious experiments of Mr Nairn and others."

When experiments require the utmoſt rarefying power of the pump, the receiver muſt not be placed on leather, either oiled or ſoaked in water, as is uſually done. The pump-plate and the edge of the receiver muſt be ground very flat and true, and this with very fine emery, that no roughneſs may remain. The plate of the pump muſt then be wiped very clean and very dry, and the receiver rubbed with a warm cloth till it become electrical. The receiver being now ſet on the plate, hog's lard, either alone or mixed with a little oil, which has been cleared of water by boiling, muſt be ſmeared round its outſide edge. In this condition the pump will rarefy its utmoſt, and what ſtill remains in the receiver will be permanent air. Or a little of this compoſition may be thinly ſmeared on the pump-plate; this will prevent all riſk of ſcratching it with the edge of the receiver. Leather of very uniform thickneſs, long dried before a fire, and well ſoaked in this compoſition, which muſt be cleared of all water by the firſt boiling, will anſwer very well, and is expeditious, when receivers are to be frequently ſhifted. Other leathers ſhould be at hand ſoaked in a compoſition containing a little roſin. This gives it a clammineſs which renders it impermeable to air, and is very proper at all joints of the pump, and all apparatus for pneumatic experiments. As it is impoſſible to render the pear-gage as dry as other parts of the the apparatus, there will be generally ſome variation between this and the other gages.

When it is only intended to ſhow the utmoſt power of the pump, without intending to aſcertain the quality of the reſidum, the receiver may be ſet on wet leather. If, in this condition, the air be rarefied as far as poſſible, the ſyphon and barometer gage will indicate a leſs degree of rarefaction than in the former experiments. But when the air is let in again, the pear-gage will point out a rarefaction ſome thouſands of times greater than it did before. If the true quality of permanent air after exhauſtion be required, the pear-gage will be neareſt the truth: for when the air is rarefied to a certain degree, the moiſtened leather emits an expanſible fluid, which, filling the receiver, forces out the permanent air; and the two firſt gages indicate a degree of exhauſtion which relates to the whole elaſtic matter remaining in the receiver, *viz.* to the expanſible fluid together with the permanent air; whereas the pear-gage points out the degree of exhauſtion, with relation to the permanent air alone, which remains in the receiver; for by the preſſure of the air admitted into the receiver, the elaſtic vapour is reduced to its former bulk, which is imperceptible.

Many bodies emit this elaſtic fluid when the preſſure of the air is much diminiſhed; a piece of leather, in its ordinary damp ſtate, about an inch ſquare, or a bit of green or dry wood, will ſupply this for a great while.

When ſuch fluids have been generated in any experiments, the pump muſt be carefully cleared of them, for they remain not only in the receiver, but in the barrels and paſſages, and will again expand when the exhauſtion has been carried far.

The beſt method of clearing the pump is to take a very large receiver, and, uſing every precaution to exhauſt it as far as poſſible. Then the expanſible matter lurking in the barrels and paſſes will be diffuſed through the receiver alſo, or will be carried off along with its air. It will be as much rarer than it was before, as the aggregate capacity of the receiver barrels and paſſes is larger than that of the two laſt.

The performance of the pump may be judged of from the four following experiments.

The two gages being ſcrewed into their places, and the hole in the receiver-plate ſhut up, the pump was made to exhauſt as far as it could. The mercury in the legs of the ſyphon was only $\frac{1}{40}$ of an inch out of the level, and that in the boiled barometer-tube $\frac{1}{40}$ of an inch higher than in the one ſcrewed to the pump. A ſtandard barometer then ſtood at 30 inches, and therefore the pump rarefied the permanent air 1200 times. This is twice as much as Mr Nairn found Mr Smeaton's do in its beſt ſtate. Mr Cavallo ſeems diſpoſed to give a favourable (while we muſt ſuppoſe it a juſt) account of Haas and Hurter's pump, and it appears never to have exceeded 600 times. Mr Cuthbertſon has often found the mercury within $\frac{1}{100}$ of an inch of the level in the ſyphon-gage, indicating a rarefaction of 3000.

To one end of a glaſs tube, 2 inches diameter and 30 inches long, was fitted a braſs cap and collar of leather, through which a wire was inſerted, reaching about two inches within the tube. This was connected with the conductor of an electric machine. The other end was ground flat and ſet on the pump-plate. When the gages indicated a rarefaction of 300, the light became ſteady and uniform, of a pale colour, though a little tinged with purple; at 600 the light was of a pale duſky white; when 1200 it diſappeared in the middle of the tube, and the tube conducted ſo well that the prime conductor only gave ſparks ſo faint and ſhort as to be ſcarcely perceptible. After taking off the tube, and making it as dry as poſſible, it was again connected with the conductor, which was giving ſparks two inches long. When the air in it was rarefied ten times, the ſparks were of the ſame length. Sometimes a pencil of light darted along the tube. When the rarefaction was 20, the ſpark did not exceed an inch, and light ſtreamed the whole length of the tube. When the rarefaction was 30, the ſparks were half an inch, and the light ruſhed along the tube in great ſtreams. When the rarefaction was 100, the ſparks were about $\frac{1}{8}$ long, and the light filled the tube in an uninterrupted body. When 300, the appearances were as before. When 600, the ſparks were $\frac{1}{10}$, and the light was of a faint white colour in the middle, but tinged with purple toward the ends. When 1200, the light was hardly perceptible in the middle, and was much fainter at the ends than before, but ſtill ruddy. When 1400, which was the moſt the pump could produce, ſix inches of the middle of the tube were quite dark, and the ends free of any tinge of red, and the ſparks did not exceed $\frac{1}{40}$ of an inch.

158 The beſt improvements of ihe air-pump have been made in Britain.

We truſt that our readers will not be diſpleaſed with the preceding hiſtory of the air-pump. The occaſional information which it gives will be of great uſe to every perſon much engaged in pneumatic experiments, and help him in the contrivance and conſtruction of the neceſſary apparatus.

We may be indulged in one remark, that although this noble inſtrument originated in Germany, all its improvements were made in Britain. Both the mechanical and pneumatical principles of Mr Boyle's conſtruction were extremely different from the German, and, in reſpect of expedition and conveniency, much ſuperior. The double barrel and gage by Hawkeſbee were capital improvements, and on principle; and Mr Smeaton's method of making the piſton work in rarefied air made a complete change in the whole proceſs.

159 Utility of the air-pump.

Aided by this machine, we can make experiments eſtabliſhing and illuſtrating the gravity and elaſticity of the air in a much more perſpicuous manner than could be done by the ſpontaneous phenomena of nature.

160 Experiments to ſhow this utility.

It allows us in the firſt place to ſhow the materiality of air in a very diſtinct manner. Bodies cannot move about in the atmoſphere without diſplacing it. This requires force; and the reſiſtance of the air always diminiſhes the velocity of bodies moving in it. A heavy body therefore has the velocity of its fall diminiſhed; and if the quantity of air diſplaced be very great, the diminution will be very conſiderable. This is the reaſon why light bodies, ſuch as feathers, fall very ſlowly. Their moving force is very ſmall, and can therefore diſplace a great quantity of air only with a very ſmall velocity. But if the ſame body be dropped *in vacuo*, when there is no air to be diſplaced, it falls with the whole velocity competent to its gravity. Fig. 29. Plate CCCCII. repreſents an apparatus by which a guinea and a downy feather are dropped at the ſame inſtant by opening the forceps which holds them by means of the ſlip-wire in the top of the receiver. If this be done after the air has been pumped out, the guinea and the feather will be obſerved to reach the bottom at the ſame inſtant.

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Fig. 30. repreſents another apparatus for ſhowing the ſame thing. It conſiſts of two ſets of braſs vanes put in ſeparate axles, in the manner of windmill ſails. One ſet has their edges placed in the direction of their whirling motion, that is, in a plane to which the axis is perpendicular. The planes of the other ſet paſs through the axis, and they are therefore trimmed ſo as directly to front the air through which they move. Two ſprings act upon pins projecting from the axis; and their ſtrength or tenſions are ſo adjuſted, that when they are diſengaged *in vacuo*, the two ſets continue in motion equally long. If they are diſengaged in the air the vanes which beat the air with their planes will ſtop long before thoſe which cut it edgewiſe.

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We can now abſtract the air almoſt completely from a dry veſſel, ſo as to know the preciſe weight of the air which filled it. The firſt experiment we have of this kind, done with accuracy, is that of Dr Hooke, Feb. 10. 1664, when he found 114 pints of air to weigh 945 grains. One pint of water was $8\frac{7}{32}$ ounces. This gives for the ſpecific gravity of air $\frac{1}{850}$ very nearly.

163 The effect of air on the weight of bodies immerſed in it. Since we are thus immerſed in a gravitating fluid, it follows, that every body preponderates only with the exceſs of its own weight above that of the air which it diſplaces; for every body loſes by this immerſion the weight of the diſplaced air. A cubic foot loſes about 521 grains in froſty weather. We ſee balloons even riſe in the air, as a piece of cork riſes in water. A maſs of water which really contains 850 pounds will load the ſcale of a balance with 849 only, and will be balanced by about $849\frac{1}{8}$ pounds of braſs. This is evinced by a very pretty experiment, repreſented in fig. 31. (Plate CCCCII.) A ſmall beam is ſuſpended within a receiver. To one end of the beam is appended a thin glaſs or copper ball, cloſe in every part. This is balanced by a ſmall piece of lead hung on the other arm. As the air is pumped out of the receiver, the ball will gradually preponderate, and will regain its equilibrium when the air is re-admitted.

164 Some naturaliſts have propoſed, and actually uſed, a large globe of light make, ſuſpended at a beam, for a barometer. If its capacity is a cubic foot, $1\frac{7}{10}$ grains will indicate the ſame change that is indicated by $\frac{1}{10}$ of an inch of an ordinary barometer. But a veſſel of this ſize will load a balance too much to leave it ſufficiently ſenſible to ſmall changes of denſity. Beſides, it is affected by heat and cold, and would require a very troubleſome equation to correct their effects.

165 It may perhaps be worth while to attend to this in buying and ſelling precious commodities; ſuch as pearls, diamonds, ſilk, and ſome drugs. As they are generally ſold by braſs or leaden weights, the buyer will have ſome advantage when the air is heavy and the barometer high. On the other hand, he will have the advantage in buying gold and mercury when the air is light. It is needleſs to confine this obſervation to precious commodities, for the advantage is the ſame in all in proportion to their levity.

166 There is a caſe in which this obſervation is of conſequence to the philoſopher: we mean the meaſuring of time by pendulums. As the accelerating force on a pendulum is not its whole weight, but the exceſs of its weight over that of the diſplaced air, it follows that a pendulum will vibrate more ſlowly in the air than *in vacuo*. A pendulum compoſed of lead, iron, and braſs, may be about 8400 times heavier than the air which it diſplaces when the barometer is at 30 inches and the thermometer at 32°, and the accelerating force will be diminiſhed about $\frac{1}{16800}$. This will cauſe a ſecond pendulum to make about five vibrations leſs in a day than it would do *in vacuo*. In order therefore to deduce the accelerative power of gravity from the length of a pendulum vibrating in the air, we muſt make an allowance of 0″, 17, or $\frac{17}{100}$ of a ſecond, per day for every inch that the barometer ſtands lower than 30 inches. But we muſt alſo note the temperature of the air; becauſe when the air is warm it is leſs denſe when ſupporting by its elaſticity the ſame weight of atmoſphere, and we muſt know how much its denſity is diminiſhed by an increaſe of temperature. The correction is ſtill more complicated; for the change of denſity affects the reſiſtance of the air, and this affects the time of the vibration, and this by a law that is not yet well aſcertained. As far as we can determine from any experiments that have been made, it appears that the change ariſing from the altered reſiſtance takes off about $\frac{2}{5}$ of the change produced by the altered denſity, and that a ſecond pendulum makes but three vibrations a day more *in vacuo* than in the open air. This is a very unexpected reſult; but it muſt be owned that the experiments have neither been numerous nor very nicely made.

The air-pump alſo allows us to ſhow the effects of the air's preſſure in a great number of amuſing and inſtructive phenomena.

167 Experiments to ſhow the effect of the air's preſſure. When the air is abſtracted from the receiver, it is ſtrongly preſſed to the pump-plate by the incumbent atmoſphere, and it ſupports this great preſſure in conſequence of its circular form. Being equally compreſſed on all ſides, there is no place where it ſhould give way rather than another; but if it be thin, and not very round, which is ſometimes the caſe, it will be cruſhed to pieces. If we take a ſquare thin phial, and apply an exhauſting ſyringe to its mouth, it will not fail being cruſhed.

As the operation of pumping is ſomething like ſucking, many of theſe phenomena are in common diſcourſe aſcribed to ſuction, a word much abuſed; and this abuſe miſleads the mind exceedingly in its contemplation of natural phenomena. Nothing is more uſual than to ſpeak of the ſuction of a ſyringe, the ſuction and draught of a chimney, &c. The following experiment puts the true cauſe of the ſtrong adheſion of the receiver beyond a doubt.

Place a ſmall receiver or cupping-glaſs on the pump-plate without covering the central hole, as repreſented in fig. 32. (Plate CCCCIII.) and cover it with a larger receiver. Exhauſt the air from it; then admit it as ſuddenly as poſſible. The outer receiver, which after the rarefaction adhered ſtrongly to the plate, is now looſe, and the cupping-glaſs will be found ſticking faſt to it. While the rarefaction was going on, the air in the ſmall receiver alſo expanded, eſcaped from it, and was abſtracted by the pump. When the external air was ſuddenly admitted, it preſſed on the ſmall receiver, and forced it down to the plate, and thus ſhut up all entry. The ſmall receiver muſt now adhere; and there can be no ſuction, for the pipe of the pump was on the outſide of the cupping-glaſs.

This experiment ſometimes does not ſucceed, becauſe the air ſometimes finds a paſſage under the brim of the cuping-glaſs. But if the cuping-glaſs be preſſed down by the hand on the greaſy leather or plate, every thing will be made ſmooth, and the glaſs will be ſo little raiſed by the expanſion of its air during the pumping, that it will inſtantly clap cloſe when the air is re-admitted.

168 In like manner, if a thin ſquare phial be furniſhed with a valve, opening from within, but ſhutting when preſſed from without, and if this phial be put under a receiver, and the air be abſtracted from the receiver, the air in the phial will expand during the rarefaction, will eſcape through the valve, and be at laſt in a very rarefied ſtate within the phial. If the air be now admitted into the receiver, it will preſs on the flat ſides of the included phial and cruſh it to pieces. See fig. 33.

169 If a piece of wet ox-bladder be laid over the top of a receiver whoſe orifice is about four inches wide, and the

Plate CCCCIII.

the air be exhauſted from within it, the incumbent atmoſphere will preſs down the bladder into a hollow form, and then burſt it inward with a prodigious noiſe. See fig. 34. Or if a piece of thin flat glaſs be laid over the receiver, with an oiled leather between them to make the juncture air-tight, the glaſs will be broken downwards. This muſt be done with caution, becauſe the pieces of glaſs ſometimes fly about with great force.

170 If there be formed two hemiſpherical cups of braſs, with very flat thick brims, and one of them be fitted with a neck and ſtopcock, as repreſented by fig. 35. the air may be abſtracted from them by ſcrewing the neck into the hole in the pump plate. To prevent the inſinuation of air, a ring of oiled leather may be put between the rims. Now unſcrew the ſphere from the pump, and fix hooks to each, and ſuſpend them from a ſtrong nail, and hang a ſcale to the loweſt. It will require a conſiderable weight to ſeparate them; namely, about 15 pounds for every ſquare inch of the great circle of the ſphere. If this be four inches diameter, it will require near 190 pounds. This pretty experiment was firſt made by Otto Guericke, and on a very great ſcale. His ſphere was of a large ſize, and, when exhauſted, the hemiſpheres could not be drawn aſunder by 20 horſes. It was exhibited, along with many others equally curious and magnificent, to the emperor of Germany and his court, at the breaking up of the diet of Ratiſbon in 1654.

171 If the loaded ſyringe mentioned in n° 16. be ſuſpended by its piſton from the hook in the top plate of the receiver, as in fig. 36. and the air be abſtracted by the pump, the ſyringe will gradually deſcend (becauſe the elaſticity of the air, which formerly balanced the preſſure of the atmoſphere, is now diminiſhed by its expanſion, and is therefore no longer able to preſs the ſyringe to the piſton), and it will at laſt drop off. If the air be admitted before this happens, the ſyringe will immediately riſe again.

172 Screw a ſhort braſs pipe into the neck of a tranſporter, n° 107. on which is ſet a tall receiver, and immerſe it into a ciſtern of water. On opening the cock the preſſure of the air on the ſurface of the water in the ciſtern will force it up through the pipe, and cauſe it to ſpout into the receiver with a ſtrong jet, becauſe there is no air within to balance by its elaſticity the preſſure of the atmoſphere. See fig. 37.

173 By means of this preſſure the gage of an air-pump acts,

It is in the ſame way that the gage of the air pump performs its office. The preſſure of the atmoſphere raiſes the mercury in the gage till the weight of the mercury, together with the remaining elaſticity of the air in the receiver, are in equilibrio with the whole preſſure of the atmoſphere: therefore the height and weight of the mercury in the gage is the exceſs of the weight of the atmoſphere above the elaſticity of the included air; and the deficiency of this height from that of the mercury in the Toricellian tube is the meaſure of this remaining elaſticity.

174 If a Toricellian tube be put under a tall receiver, as ſhown in fig. 38. and the air be exhauſted, the mercury in the tube will deſcend while that in the gage will riſe; and the ſum of their heights will always be the ſame, that is, equal to the height in an ordinary barometer. The height of the mercury in the receiver is the effect and meaſure of the remaining elaſticity of the included air, and the height in the pump gage is the unbalanced preſſure of the atmoſphere. This is a very inſtructive experiment, perfectly ſimilar to Mr Auzout's, mentioned in n° 34. and completely eſtabliſhes and illuſtrates the whole doctrine of atmoſpheric preſſure.

175 Water riſes in pumps,

We get a ſimilar illuſtration and confirmation (if ſuch a thing be now needed) of the cauſe of the riſe of water in pumps, by ſcrewing a ſyringe into the top plate of a receiver, which ſyringe has a ſhort glaſs pipe plunging into a ſmall cup of water. See fig. 39. When the piſton-rod is drawn up, the water riſes in the glaſs pipe, as in any other pump, of which this is a miniature repreſentation. But if the air has been previouſly exhauſted from the receiver, there is nothing to preſs on the water in the little jar; and it will not riſe in the glaſs pipe though the piſton of the ſyringe be drawn to the top.

176 and moves in ſyphons,

Analagous to the riſe of water in pumps is its riſe and motion in ſyphons. Suppoſe a pipe ABCD, fig. 40. bent at right angles at B and C, and having its two ends immerſed in the ciſterns of water A and D. Let the leg CD be longer than the leg BA, and let the whole be full of water. The water is preſſed upwards at A with a force equal to the weight of the column of air EA reaching to the top of the atmoſphere; but it is preſſed downwards by the weight of the column of water BA. The water at E is preſſed downwards by the weight of the column CD, and upwards by the weight of the column of air FD reaching to the top of the atmoſphere. The two columns of air differ very little in their weight, and may without any ſenſible error be conſidered as equal. Therefore there is a ſuperiority of preſſure downwards at D, and the water will flow out there. The preſſure of the air will raiſe the water in the leg AB, and thus the ſtream will be kept up till the veſſel A is emptied as low as the orifice of the leg BA, provided the height of AB is not greater than what the preſſure of the atmoſphere can balance, that is, does not exceed 32 or 33 feet for water, 30 inches for mercury, &c.

A ſyphon then will always run from that veſſel whoſe ſurface is higheſt; the form of the pipe is indifferent, becauſe the hydroſtatical preſſures depend on the vertical height only. It muſt be filled with water by ſome other contrivance, ſuch as a funnel, or a pump applied a-top; and the funnel muſt be ſtopped up, otherwiſe the air would get in, and the water would fall in both legs.

177 If the ſyphon have equal legs, as in fig. 41. and be turned up at the ends, it will remain full of water, and be ready for uſe. It need only be dipped into any veſſel of water, and the water will then flow out at the other end of the ſyphon. This is called the *Wirtinberg ſyphon*, and is repreſented in fig. 41. Syphons will afterwards be conſidered more minutely under the title of *Pneumatical Engines*, at the end of this article.

178 The ſyphon fountain.

What is called the *ſyphon fountain*, conſtructed on this principle, is ſhown in fig. 42. where AB is a tall receiver, ſtanding in a wide baſon DE, which is ſupported on the pedeſtal H by the hollow pillar FG. In the centre of the receiver is a jet pipe C, and in the top a ground ſtopper A. Near the baſe of the pillar is a cock N, and in the pedeſtal is another cock O.

Fill the baſon DE with water within half an inch of the brim. Then pour in water at the top of the receiver (the cock N being ſhut) till it is about half full, and then put in the ſtopper. A little water will run out into the veſſel DE. But before it runs over, open the cock N, and the water will run into the ciſtern H; and by the time that the pipe C appears above water, a jet will riſe from it, and continue as long as water is ſupplied from the baſon DE. The paſſage into the baſe ciſtern may be ſo tempered by the cock N that the water within the receiver ſhall keep at the ſame height, and what runs into the baſe may be received from the cock O into another veſſel, and returned into DE, to keep up the ſtream.

179
Manner of its conſtruction and operation.
Plate CCCCIII.

This pretty philoſophical toy may be conſtructed in the following manner. BB, fig. 42. nº 2. is the ferril or cap into which the receiver is cemented. From its centre deſcends the jet pipe C *a*, ſloping outwards, to give room for the diſcharging pipe *b d* of larger diameter, whoſe lower extremity *d* fits tightly into the top of the hollow pillar FG.

The operation of the toy is eaſily underſtood. Suppoſe the diſtance from C to H (nº 1.) three feet, which is about $\frac{1}{11}$ of the height at which the atmoſphere would ſupport a column of water. The water poured into AB would deſcend through FG (the hole A being ſhut) till the air has expanded $\frac{1}{10}$, and then it would ſtop. If the pipe C*a* be now opened, the preſſure of the air on the ſurface of the water in the ciſtern DE will cauſe it to ſpout through C to the height of three feet nearly, and the water will continue to deſcend through the pipe FG. By tempering the cock N ſo as to allow the water to paſs through it as faſt as it is ſupplied by the jet, the amuſement may be continued a long time. It will ſtop at laſt, however; becauſe, as the jet is made into rarefied air, a little air will be extricated from the water, which will gradually accumulate in the receiver, and diminiſh its rarefaction, which is the moving cauſe of the jet. This indeed is an inconvenience felt in every employment of ſyphons, ſo much the more remarkably as their top is higher than the ſurface of the water in the ciſtern of ſupply.

180
Syphons are often uſed thus.

Caſes of this employment of a ſyphon are not unfrequent. When water collected at A (fig. 43.) is to be conducted in a pipe to C, ſituated in a lower part of the country, it ſometimes happens, as between Lochend and Leith, that the intervening ground is higher than the fountain-head as at B. A forcing pump is erected at A, and the water forced along the pipe. Once it runs out at C, the pump may be removed, and the water will continue to run on the ſyphon principle, provided BD do not exceeed 33 feet. But the water in that part of the conduit which is above the horizontal plane AD, is in the ſame ſtate as in a receiver of rarefied air, and gives out ſome of the air which is chemically united with it. This gradually accumulates in the elevated part of the conduit, and at laſt choaks entirely. When this happens, the forcing pump muſt again be worked. Although the elevation in the Leith conduit is only about eight or ten feet, it will ſeldom run for 12 hours. N. B. This air cannot be diſcharged by the uſual air-cocks; for if there were an opening at B, the air would ruſh in, and immediately ſtop the motion.

181
The air-pump diſcovers the combination of air with water.

This combination of air with water is very diſtinctly ſeen by means of the air-pump. If a ſmall glaſs containing cold water, freſh drawn from the ſpring be expoſed, as in fig. 44. under the receiver, and the air rarefied, ſmall bubbles will be obſerved to form on the inner ſurface of the glaſs, or on the ſurface of any body immerſed in it, which will increaſe in ſize, and then detach themſelves from the glaſs and reach the top; as the rarefaction advances, the whole water begins to ſhow very minute air-bubbles riſing to the top; and this appearance will continue for a very long time, till it be completely diſengaged. Warming the water will occaſion a ſtill farther ſeparation of air, and a boiling heat will ſeparate all that can be diſengaged. The reaſon aſſigned for theſe air-bubbles firſt appearing on the ſurface of the glaſs, &c. is, that air is attracted by bodies, and adheres to their ſurface. This may be ſo. But it is more probably owing to the attraction of the water for the glaſs, which cauſes it to quit the air which it held in ſolution, in the ſame manner as we ſee it happen when it is mixed with ſpirits-of-wine, with vitriolic acid, &c. or when ſalts or ſugar are diſſolved in it. For if we pour out the water which has been purged of air by boiling *in vacuo*, and fill the glaſs with freſh water, we ſhall obſerve the ſame thing, although a film of the purified water was left adhering to the glaſs. In this caſe there can be no air adhering to the glaſs.

Plate CCCCIV.

182

Water thus purged of air by boiling (or even without boiling) *in vacuo*, will again abſorb air when expoſed to the atmoſphere. The beſt demonſtration of this is to fill with this water a phial, leaving about the ſize of a pea not filled. Immerſe this in a veſſel of water, with the mouth undermoſt, by which means the air-bubble will mount up to the bottom of the phial. After ſome days ſtanding in this condition, the air-bubble will be completely abſorbed, and the veſſel quite filled with water.

The air in this ſtate of chemical ſolution has loſt its elaſticity, for the water is not more compreſſible than common water. It is alſo found that water brought up from a great depth under ground contains much more air than water at the ſurface. Indeed fountain waters differ exceedingly in this reſpect. The water which now comes into the city of Edinburgh by pipes contains ſo much as to throw it into a conſiderable ebullition *in vacuo*. Other liquors contain much greater quantities of elaſtic fluids in this looſely combined ſtate. A glaſs of beer treated in the ſame way will be almoſt wholly converted into froth by the eſcape of its fixed air, and will have loſt entirely the prickling ſmartneſs which is ſo agreeable, and it become quite vapid.

183
And illuſtrates the air's elaſticity and expanſibility.

The air-pump gives us, in the next place, a great variety of experiments illuſtrative of the air's elaſticity and expanſibility. The very operation of exhauſtion, as it is called, is an inſtance of its great, and hitherto unlimited, expanſibility. But this is not palpably exhibited to view. The following experiments ſhow it moſt diſtinctly.

184
Experiments ſhowing theſe properties.

1ſt, Put a flaccid bladder, of which the neck is firmly tied with a thread, under a receiver, and work the pump. The bladder will gradually ſwell, and will even be fully diſtended. Upon readmitting the air into the receiver, the bladder gradually collapſes again into its former dimenſions: while the bladder is flaccid, the air within it is of the ſame denſity and elaſticity with the ſurrounding air, and its elaſticity balances the preſſure of the atmoſphere. When part of the air of the receiver is abſtracted, the remainder expands ſo as ſtill to fill the receiver: but by expanding, its elaſticity is plainly diminiſhed; for we ſee by the fact, that the elaſticity of the air of the receiver no longer balances the elaſticity of that in the bladder, as it no longer keeps it in its dimenſions. The air in the bladder expands alſo: it expands till its diminiſhed elaſticity is again in equilibrio with the diminiſhed elaſticity of the air in the receiver; that is, till its denſity is the ſame. When all the wrinkles of the bladder have diſappeared, its air can expand no more, although we continue to diminiſh the elaſticity of the air of the receiver by further rarefaction. The bladder now tends to burſt; and if it be pierced by a point or knife faſtened to the ſlip-wire, the air will ruſh out and the mercury deſcend rapidly in the gage.

185 If a phial or tube be partly filled with water, and immerſed in a veſſel of water with the mouth downwards, the air will occupy the upper part of the phial. If this apparatus be put under a receiver, and the air be abſtracted, the air in the phial will gradually expand, allowing the water to run out by its weight till the ſurface of the water be on a level within and without. When this is the caſe, we muſt grant that the denſity and elaſticity of the air in the phial is the ſame with that in the receiver. When we work the pump again, we ſhall obſerve the air in the phial expand ſtill more, and come out of the water in bubbles. Continuing the operation, we ſhall ſee the air continually eſcaping from the phial: when this is over, it ſhows that the pump can rarefy no more. If we now admit the air into the receiver, we ſhall ſee the water riſe into the phial, and at laſt almoſt completely fill it, leaving only a very ſmall bubble of air at top. This bubble had expanded ſo as to fill the whole phial. See this repreſented in fig. 45.

Plate CCCIV.

186 Every one muſt have obſerved a cavity at the big end of an egg between the ſhell and the white. The white and yolk are contained in a thin membrane or bladder which adheres looſely to the ſhell, but is detached from it at that part; and this cavity increaſes by keeping the egg in a dry place. One may form a judgment of its ſize, and therefore of the freſhneſs of the egg, by touching it with the tongue; for the ſhell, where it is not in contact with the contents, will preſently feel warm, being quickly heated by the tongue, while the reſt of the egg will feel cold.

If a hole be made in the oppoſite end of the egg, and it be ſet on a little tripod, and put under a receiver, the expanſion of the air in the cavity of the egg will force the contents through the hole till the egg be quite emptied: or, if nearly one half of the egg be taken away at the other end, and the white and yolk taken out, and the ſhell be put under a receiver, and the air abſtracted, the air in the cavity of the egg will expand, gradually detaching the membrane from the ſhell, till the air cauſes it to ſwell out, and gives the whole the appearance of an entire egg.—In like manner ſhrivelled apples and other fruits will ſwell in vacuo by the expanſion of the air confined in their cavities.

187 If a piece of wood, a twig with green leaves, charcoal, plaſter of Paris, &c. be kept under water in vacuo, a prodigious quantity of air will be extracted; and if we readmit the air into the receiver, it will force the water into the pores of the body. In this caſe the body will not ſwim in water as it did before, ſhowing that the vegetable fibres are ſpecifically heavier than water. It is found, however, that the air contained in the pith and bark, ſuch as cork, is not all extricated in this way; and that much of it is contained in veſicles which have no outlet: being ſecreted into them in the proceſs of vegetation, as it is ſecreted into the air-bladder of fiſhes, where it is generally found in a pretty compreſſed ſtate, conſiderably denſer than the ſurrounding air. The air-bladder of a fiſh is ſurrounded by circular and longitudinal muſcles, by which the fiſh can compreſs the air ſtill further; and, by ceaſing to act with them, allow it to ſwell out again. It is in this manner that the fiſh can ſuit its ſpecific gravity to its ſituation in the water, ſo as to have no tendency either to riſe or ſink; but if the fiſh be put into the receiver of an air-pump, the rarefaction of the air obliges the fiſh to act more ſtrongly with theſe contracting muſcles, in order to adjuſt its ſpecific gravity; and if too much air has been abſtracted from the receiver, the fiſh is no longer able to keep its air-bladder in the proper degree of compreſſion. It becomes therefore too buoyant, and comes to the top of the water, and is obliged to ſtruggle with its tail and fins in order to get down; frequently in vain. The air-bladder ſometimes burſts, and the fiſh goes to the bottom, and can no longer keep above without the continual action of its tail and fins. When fiſhes die, they commonly float at top, their contractive action being now at an end. All this may be illuſtrated (but very imperfectly) by a ſmall half-blown bladder, to which is appended a bit of lead, juſt ſo heavy as to make it ſink in water; when this is put under a receiver, and the air abſtracted, the bubble will riſe to the top; and, by nicely adjuſting the rarefaction, it may be kept at any height. See fig. 46.

188 The play-things called *Carteſian devils* are ſimilar to this: they are hollow glaſs figures, having a ſmall aperture in the lower part of the figures, as at the point of the foot; their weight is adjuſted ſo that they ſwim upright in water. When put into a tall jar filled to the top, and having a piece of leather tied over it they will ſink in the water, by preſſing on the leather with the ball of the hand: this, by compreſſing the water, forces ſome of it to enter into the figure and makes it heavier than the water; for which reaſon it ſinks, but riſes again on removing the preſſure of the hand. See fig. 47. n° 1. and 2.

If a half-blown ox-bladder be put into a box, and great weights laid on it, and the whole be put under a receiver, and the air abſtracted; the air will, by expanding, lift up the weights, though above an hundred pounds. See fig. 48.

189 Compreſſibility and expanſibility are in no ſtate of the air very diſſimilar.

By ſuch experiments the great expanſibility of the air is abundantly illuſtrated, as its compreſſibility was formerly by means of the condenſing ſyringe. We now ſee that the two ſets of experiments form an uninterrupted chain; and that there is no particular ſtate of the air's denſity where the compreſſibility and expanſibility is remarkably diſſimilar. Air in its ordinary ſtate expands; becauſe its ordinary ſtate is a ſtate of compreſſion by the weight of the atmoſphere: and if there were a pit about 33 miles deep, the air at the bottom would probably be as denſe as water; and if it were 50 miles deep, it would be as denſe as gold, if it did not become a liquid before this depth: nay, if a bottle with its mouth undermoſt were immerſed ſix miles under water, it would probably be as denſe as water; we ſay probably, for this depends on the nature of its compreſſibility

Fig. 32.

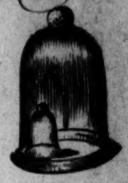

Fig. 33.

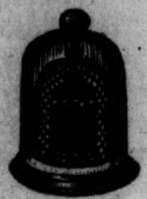

Fig. 34.

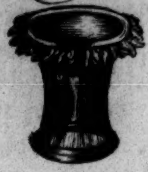

Fig. 35.

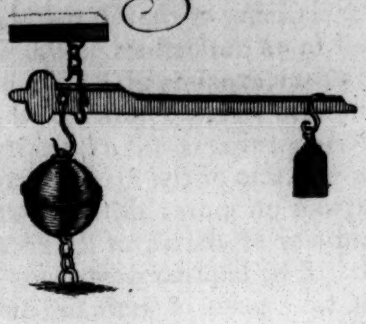

Fig. 36.

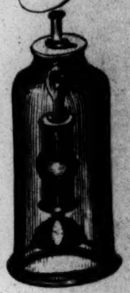

Fig. 40.

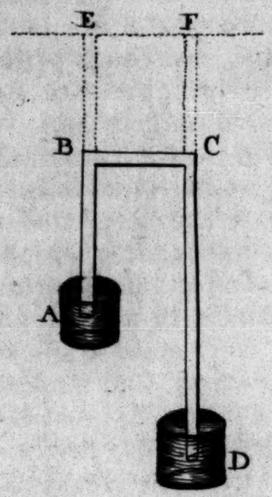

Fig. 42. No. 1.

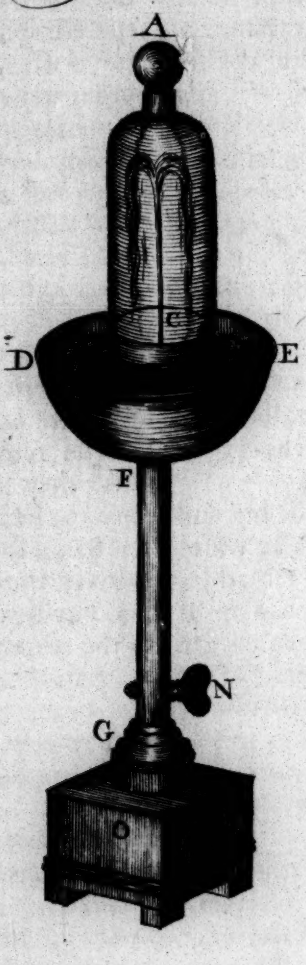

Fig. 41.

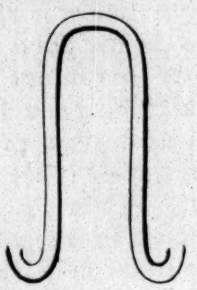

Fig. 38.

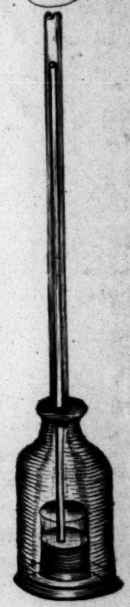

Fig. 42. No. 2.

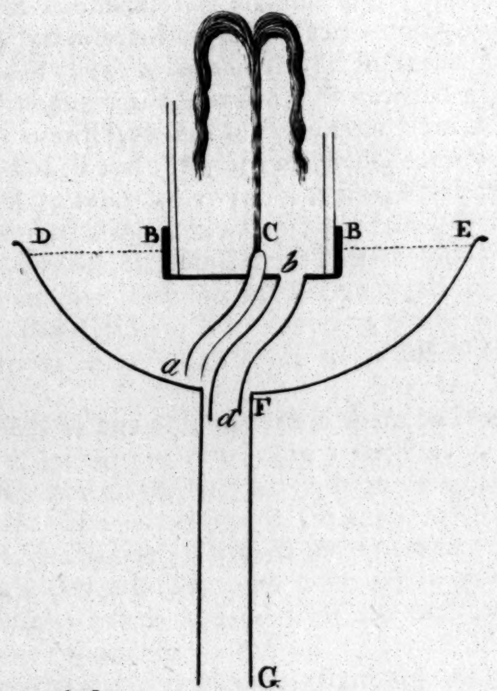
D
B
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Fig. 37.

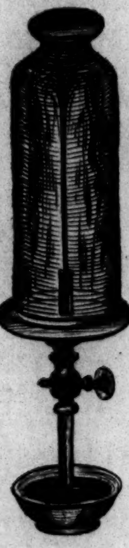


Fig. 39.

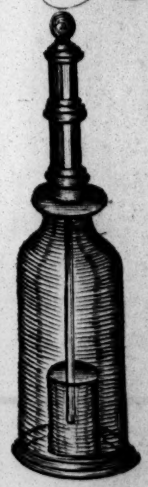
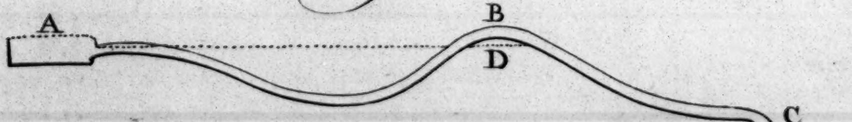


Fig. 43.



Trenchard.

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ſibility; that is, on the relation which ſubſiſts between the compreſſion and the force which produces it.

190 Relation between compreſſion and the force producing it.

This is the circumſtance of its conſtitution, which we now proceed to examine; and it is evidently a very important circumſtance. We have long ago obſerved, that the great compreſſibility and permanent fluidity of air, obſerved in a vaſt variety of phenomena, is totally inexplicable, on the ſuppoſition that the particles of air are like ſo many balls of ſponge or ſo many foot-balls. Give to thoſe what compreſſibility you pleaſe, common air could no more be fluid than a maſs of clay; it could no more be fluid than a maſs of ſuch balls preſſed into a box. It can be demonſtrated (and indeed hardly needs a demonſtration), that before a parcel of ſuch balls, juſt touching each other, can be ſqueezed into half their preſent dimenſions, their globular ſhape will be entirely gone, and each will have become a perfect cube, touching ſix other cubes with its whole ſurface; and theſe cubes will be ſtrongly compreſſed together, ſo that motion could never be performed through among them by any ſolid body without a very great force. Whereas we know that in this ſtate air is juſt as permeable to every body as the common air that we breathe. There is no way in which we can repreſent this fluidity to our imagination but by conceiving air to conſiſt of particles, not only diſcrete, but diſtant from each other, and actuated by repulſive forces, or ſomething analogous to them. It is an idle ſubterfuge, to which ſome naturaliſts have recourſe, ſaying, that they are kept aſunder by an intervening ether, or elaſtic fluid of any other name. This is only removing the difficulty a ſtep farther off: for the elaſticity of this fluid requires the ſame explanation; and therefore it is neceſſary, in obedience to the rules of juſt reaſoning, to begin the inquiry here; that is, to determine from the phenomena what is the analogy between the diſtances of the particles and the repulſive forces exerted at theſe diſtances, proceeding in the ſame way as in the examination of planetary gravitation. We ſhall learn the analogy by attending to the analogy between the compreſſing force and the denſity.

191 Denſity explained as applied to air.

For the denſity depends on the diſtance between the particles; the nearer they are to each other, the denſer is the air. Suppoſe a ſquare pipe one inch wide and eight inches long, ſhut at one end, and filled with common air; then ſuppoſe a plug ſo nicely fitted to this pipe that no air can paſs by its ſides; ſuppoſe this piſton thruſt down to within an inch of the bottom: it is evident that the air which formerly filled the whole pipe now occupies the ſpace of one cubic inch, which contains the ſame number of particles as were formerly diffuſed over eight cubic inches.

The condenſation would have been the ſame if the air which fills a cube whoſe ſide is two inches had been ſqueezed into a cube of one inch, for the cube of two inches alſo contains eight inches. Now, in this caſe it is evident that the diſtance between the particles would be reduced to its half in every direction. In like manner, if a cube whoſe ſide is three inches, and which therefore contains 27 inches, be ſqueezed into one inch, the diſtance of the particles will be one third of what it was: in general the diſtance of the particles will be as the cube-root of the ſpace into which they are compreſſed. If the ſpace be $\frac{1}{8}$, $\frac{1}{27}$, $\frac{1}{64}$, $\frac{1}{125}$, &c. of its former dimenſions, the diſtance of the particles will be $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c. Now the term *denſity*, in its ſtrict ſenſe, expreſſes the vicinity of the particles; *denſi arbores* are trees growing near each other. The meaſure of this vicinity therefore is the true meaſure of the denſity; and when 27 inches of air are compreſſed into one, we ſhould ſay that it is three times as denſe; but we ſay, that it is 27 times denſer.

192 Farther explanation.

Denſity is therefore uſed in a ſenſe different from its ſtricteſt acceptation: it expreſſes the comparative number of equidiſtant particles contained in the ſame bulk. This is alſo abundantly preciſe, when we compare bodies of the ſame kind differing in denſity only; but we alſo ſay, that gold is 19 times denſer than water, becauſe the ſame bulk of it is 19 times heavier. This aſſertion proceeds on the aſſumption, or the fact, that every ultimate atom of terreſtrial matter is equally heavy: a particle of gold may contain more or fewer atoms of matter than a particle of water. In ſuch a caſe, therefore, the term denſity has little or no reference to the vicinity of the particles; and is only a term of compariſon of other qualities or accidents.

But when we ſpeak of the reſpective denſities of the ſame ſubſtance in its different ſtates of compreſſion, the word *denſity* is ſtrictly connected with vicinity of particles, and we may ſafely take either of the meaſures. We ſhall abide by the common acceptation, and call that air eight times as denſe which has eight times as many particles in the ſame bulk, although the particles are only twice as near to each other.

193 The analogy between the compreſſing force and the diſtance of the particles, &c.

Thus then we ſee, that by obſerving the analogy between the compreſſing force and the denſity, we ſhall diſcover the analogy between the compreſſing force and the diſtance of the particles. Now the force which is neceſſary for compreſſing two particles of air to a certain vicinity is a proper meaſure of the elaſticity of the particles correſponding to that vicinity or diſtance; for it balances it, and forces which balance muſt be eſteemed equal. Elaſticity is a diſtinctive name for that corpuſcular force which keeps the particles at that diſtance: therefore obſervations made on the analogy between the compreſſing force and the denſity of air will give us the law of its corpuſcular force, in the ſame way that obſervations on the ſimultaneous deflections of the planets towards the ſun give us the law of celeſtial gravitation.

194

But the ſenſible compreſſing forces which we are able to apply is at once exerted on unknown thouſands of particles, while it is the law of action of a ſingle particle that we want to diſcover. We muſt therefore know the *proportion* of the numbers of particles on which the compreſſing force is exerted. It is eaſy to ſee, that ſince the diſtance of the particles is as the cube root of the denſity inverſely, the number of particles in phyſical contact with the compreſſing ſurface muſt be as the ſquare of this root. Thus when a cube of 8 inches is compreſſed into one inch, and the particles are twice as near each other as they were before, there muſt be four times the number of particles in contact with each of the ſides of this cubical inch; or, when we have puſhed down the ſquare piſton of the pipe ſpoken of above to within an inch of the bottom, there will be four times the number of particles *immediately* contiguous to the piſton, and reſiſting the compreſſion; and in order to obtain the force really exerted on one particle, and the elaſticity of that particle, we muſt divide the whole compreſſing force by 4. In like manner, if we have compreſſed

preſſed air into $\frac{1}{27}$ of its former bulk, and brought the particles to $\frac{1}{3}$ of their former diſtance, we muſt divide the compreſſing force by 9. In general if d expreſs the denſity, $\frac{1}{\sqrt[3]{d}}$ will expreſs the diſtance x of the particles; $\sqrt[3]{d}$, or $d^{\frac{1}{3}}$, will expreſs the vicinity or real denſity; and $d^{\frac{2}{3}}$, will expreſs the number of particles acting on the compreſſing ſurface: and if f expreſs the accumulated external compreſſing force, $\frac{f}{d^{\frac{2}{3}}}$ will expreſs the ſorce acting on one particle; and therefore the elaſticity of that particle correſponding to the diſtance x.

195 Experiments eſtabliſhing the law of compreſſion.

We may now proceed to conſider the experiment by which the law of compreſſion is to be eſtabliſhed.

The firſt experiments to this purpoſe were thoſe made by Mr Boyle, publiſhed in 1661 in his *Defenſio Doctrinæ de Aeris Elatere contra Linum*, and exhibited before the Royal Society the year before. Mariotte made experiments of the ſame kind, which were publiſhed in 1676 in his *Eſſai ſur la Nature de l'Air* and *Traité des Mouvemens des Eaux*. The moſt copious experiments are thoſe by Sulzer (*Mem. Berlin.* ix.), thoſe by Fontana (*Opuſc. Phyſico-Math.*), and thoſe by Sir George Shuckbourgh and Gen. Roy.

196 Compreſſibility of air not rarer than the atmoſphere at the earth's ſurface.

Plate CCCCIV.

In order to examine the compreſſibility of air that is not rarer than the atmoſphere at the ſurface of the earth, we employ a bent tube or ſyphon ABCD (fig. 49.), hermetically ſealed at A and open at D. The ſhort leg AB muſt be very accurately divided in the proportion of its ſolid contents, and fitted with a ſcale whoſe units denote equal increments, not of length, but of capacity. There are various ways of doing this; but it requires the moſt ſcrupulous attention, and without this the experiments are of no value. In particular, the arched form at A muſt be noticed. A ſmall quantity of mercury muſt then be poured into the tube, and paſſed backwards and forwards till it ſtands (the tube being held in a vertical poſition) on a level at B and C. Then we are certain that the included air is of the ſame denſity with that of the contiguous atmoſpere. Mercury is now poured into the leg DC, which will fill it, ſuppoſe to G, and will compreſs the air into a ſmaller ſpace AE. Draw the horizontal line EF: the new bulk of the compreſſed air is evidently AE, meaſured by the adjacent ſcale, and the addition made to the compreſſing force of the atmoſphere is the weight of the column GF. Produce GF downwards to H, till FH is equal to the height ſhown by a Toricellian tube filled with the *ſame mercury*; then the whole compreſſing force is HG. This is evidently the meaſure of the elaſticity of the compreſſed air in AE, for it balances it. Now pour in more mercury, and let it ii e to g, compreſſing the air into A e. Draw the horizontal line ef, and make fh equal to FH; then A e will be the new bulk of the compreſſed air, $\frac{\mathrm{AB}}{\mathrm{A}e}$ will be its new denſity, and hg will be the meaſure of the new elaſticity. This operation may be extended as far as we pleaſe, by lengthening the tube CD, and taking care that it be ſtrong enough to reſiſt the great preſſure. Great care muſt be taken to keep the whole in a conſtant temperature, becauſe the elaſticity of air is greatly affected by heat, and the change by any increaſe of temperature is different according to its denſity or compreſſion.

197 Experiments of Boyle, &c. neither nicely made not extended to very great compreſſions.

The experiments of Boyle, Mariotte, Amontons, and others, were not extended to very great compreſſions, the denſity of the air not having been quadrupled in any of them; nor do they ſeem to have been made with very great nicety. It may be collected from them in general, that the elaſticity of the air is very nearly proportioned to its denſity; and accordingly this law was almoſt immediately acquieſced in, and was called the *Boylean law*: it is accordingly aſſumed by almoſt all writers on the ſubject as exact. Of late years, however, there occurred queſtions in which it was of importance that this point ſhould be more ſcrupulouſly ſettled, and the former experiments were repeated and extended. Sulzer and Fontana have carried them farther than any other. Sulzer compreſſed air into $\frac{1}{8}$ of its former dimenſions.

198 Varieties, &c in theſe experiments.

Conſiderable varieties and irregularities are to be obſerved in theſe experiments. It is extremely difficult to preſerve the temperature of the apparatus, particularly of the leg AB, which is moſt handled. A great quantity of mercury muſt be employed; and it does not appear that philoſophers have been careful to have it preciſely ſimilar to that in the barometer, which gives us the unit of compreſſing force and of elaſticity. The mercury in the barometer ſhould be pure and boiled. If the mercury in the ſyphon is adulterated with biſmuth and tin, which it commonly is to a conſiderable degree, the compreſſing force, and conſequently the elaſticity, will appear greater than the truth. If the barometer has not been nicely fitted, it will be lower than it ſhould be, and the compreſſing force will appear too great, becauſe the unit is too ſmall; and this error will be moſt remarkable in the ſmaller compreſſions.

199 Heterogeneous nature of the air the greateſt ſource of error.

The greateſt ſource of error and irregularity in the experiments is the very heterogeneous nature of the air itſelf. Air is a ſolvent of all fluids, all vapours, and perhaps of many ſolid bodies. It is highly improbable that the different compounds ſhall have the ſame elaſticity, or even the ſame law of elaſticity: and it is well known, that air, loaded with water or other volatile bodies, is much more expanſible by heat than pure air; nay, it would appear from many experiments, that certain determinate changes both of denſity and of temperature, cauſe air to let go the vapours which it holds in ſolution. Cold cauſes it to precipitate water, as appears in dew; ſo does rarefaction, as is ſeen in the receiver of an air-pump.

200 The air's elaſticity does not increaſe ſo faſt as its denſity.

In general, it appears that the elaſticity of air does not increaſe quite ſo faſt as its denſity. This will be beſt ſeen by the following tables, calculated from the experiments of Mr Sulzer. The column E in each ſet of experiments expreſſes the length of the column GH, the unit being FH, while the column D expreſſes $\frac{\mathrm{AB}}{\mathrm{AE}}$.

1ſt Set.		2d Set.		3d Set.	
D	E	D	E	D	E
1,000	1,000	1,000	1,000	1,000	1,000
1,100	1,093	1,236	1,224	1,091	1,076
1,222	1,211	1,294	1,288	1,200	1,183
1,375	1,284	1,375	1,332	1,333	1,303
1,571	1,559	1,466	1,417	1,500	1,472
1,692	1,669	1,571	1,515	1,714	1,659
1,833	1,796	1,692	1,647		
2,000	1,958	2,000	1,964	2,000	1,900
2,288	2,130				
2,444	2,375	2,444	2,392	2,400	2,241
3,143	2,936	3,143	3,078	3,000	2,793
3,666	3,391	3,666	3,575		
4,000	3,706			4,000	3,631
4,444	4,035	4,444	4,320		
4,888	4,438				
5,500	4,922	5,500	5,096		
5,882	5,522			6,000	5,297
		7,333	6,694		
				8,000	6,835

201 There appears in theſe experiments ſufficient grounds for calling in queſtion the Boylean law; and the writer of this article thought it incumbent on him to repeat them with ſome precautions, which probably had not been attended to by Mr Sulzer. He was particularly anxious to have the air as free as poſſible from moiſture. For this purpoſe, having detached the ſhort leg of the ſyphon, which was 34 inches long, he boiled mercury in it, and filled it with mercury boiling hot. He took a tinplate veſſel of ſufficient capacity, and put into it a quantity of powdered quicklime juſt taken from the kiln; and having cloſed the mouth, he agitated the lime through the air in the veſſel, and allowed it to remain there all night. He then emptied the mercury out of the ſyphon into this veſſel, keeping the open end far within it. By this means the ſhort leg of the ſyphon was filled with very dry air. The other part was now joined, and boiled mercury put into the bend of the ſyphon; and the experiment was then proſecuted with mercury which had been recently boiled, and was the ſame with which the barometer had been carefully filled.

202 The reſults of the experimenes are expreſſed in the following table.

Dry Air.		Moiſt Air.		Camp. Air.	
D	E	D	E	D	E
1,000	1,000	1,000	1,000	1,000	1,000
2,000	1,957	2,000	1,920	2,000	1,909
3,000	2,848	3,000	2,839	3,000	2,845
4,000	3,737	4,000	3,726	4,000	3,718
5,500	4,930	5,500	5,000	5,500	5,104
6,000	5,342	6,000	5,452	6,000	5,463
7,620	6,490	7.620	6.775	7 620	6,812

Here it appears again in the cleareſt manner that the elaſticities do not increaſe as faſt as the denſities. and the differences are even greater than in Mr Sulzer's experiments.

203 The ſecond table contains the reſults of experiments made in very damp air on a warm ſummer's morning. In theſe it appears that the elaſticities are almoſt preciſely proportional to the denſities + a ſmall conſtant quantity, nearly 0,11 deviating from this rule chiefly between the denſities 1 and 1,5, within which limits we have very nearly $D=E^{1.0017}$. As this air is nearer to the conſtitution of atmoſpheric air than the former, this rule may be ſafely followed in caſes where atmoſpheric air is concerned, as in meaſuring the depths of pits by the barometer.

204 The third table ſhows the compreſſion and elaſticity of air ſtrongly impregnated with the vapours of camphire. Here the Boylean law appears pretty exact, or rather the elaſticity ſeems to increaſe a little faſter than the denſity.

205 Dr Hooke examined the compreſſion of air by immerſing a bottle to great depths in the ſea, and weighing the water which got into it without any eſcape of air. But this method was liable to great uncertainty, on account of the unknown temperature of the ſea at great depths.

206 Mode of examining the elaſticity of rarefied air. Plate CCCIV.

Hitherto we have conſidered only ſuch air as is not rarer than what we breathe; we muſt take a very different method for examining the elaſticity of rarefied air.

Let *gh* (fig. 50.) be a long tube, formed a-top into a cup, and of ſufficient diameter to receive another ſmaller tube *af*, open at firſt at both ends. Let the outer tube and cup be filled with mercury, which will riſe in the inner tube to the ſame level. Let *af* now be ſtopped at *a*. It contains air of the ſame denſity and elaſticity with the adjoining atmoſphere. Note exactly the ſpace *ab* which it occupies. Draw it up into the poſition of fig. 51. and let the mercury ſtand in it at the height *de*, while *ce* is the height of the mercury in the barometer. It is evident that the column *de* is in equilibrio between the preſſure of the atmoſphere and the elaſticity of the air included in the ſpace *ad*. And ſince the weight of *ce* would be in equilibrio with the whole preſſure of the atmoſphere, the weight of *cd* is equivalent to the elaſticity of the included air. While therefore *ce* is the meaſure of the elaſticity of the ſurrounding atmoſphere, *cd* will be the meaſure of the elaſticity of the included air; and ſince the air originally occupied the ſpace *ab*, and has now expanded into *ad*, we have $\frac{ab}{ad}$ for the meaſure of its denſity. N. B. *ce* and *cd* are meaſured by the *perpendicular heights* of the columns, but *ab* and *ad* muſt be meaſured by their *ſolid capacities*.

207 By raiſing the inner tube ſtill higher, the mercury will alſo riſe higher, and the included air will expand ſtill farther, and we obtain another *cd*, and another $\frac{ab}{ad}$; and in this manner the relation between the denſity and elaſticity of rarefied air may be diſcovered.

208 An eaſier method by means of the air-pump.

This examination may be managed more eaſily by means of the air-pump. Suppoſe a tube *ae* (fig. 52.) containing a ſmall quantity of air *ab*, ſet up in a ciſtern of mercury, which is ſupported in the tube at the height *eb*, and let *ec* be the height of the mercury in the barometer. Let this apparatus be ſet under a tubulated receiver on the pump-plate, and let *gn* be the pump-gage, and *mn* be made equal to *ec*.

Then, as has been already ſhown, *cb* is the meaſure of the elaſticity of the air in *ab*, correſponding to the bulk *ab*. Now let ſome air be abſtracted from the receiver. The elaſticity of the remainder will be diminiſhed by its expanſion; and therefore the mercury in the tube *ae* will deſcend to ſome point *d*. For the ſame reaſon, the mercury in the gage will riſe to ſome point *o*, and *mo* will expreſs the elaſticity of the air in the receiver. This would ſupport the mercury in the tube *ae* at the height *er*, if the ſpace *ar* were entirely void of air. Therefore *rd* is the effect and meaſure of the elaſticity of the included air when it has expanded to the bulk *ad*; and thus its elaſticity, under a variety of other bulks, may be compared with its elaſticity when of the bulk *ab*. When the air has been ſo far abſtracted from the receiver that the mercury in *ae* deſcends to *e*, then *mo* will be the preciſe meaſure of its elaſticity.

In all theſe caſes it is neceſſary to compare its bulk *ab* with its natural bulk, in which its elaſticity balances the preſſure of the atmoſphere. This may be done by laying the tube *ae* horizontally and then the air will collapſe into its ordinary bulk.

209
Another eaſy method.
Plate CCCCIV.

Another eaſy method may be taken for this examination. Let an apparatus *abcdef* (fig. 53.) be made, conſiſting of a horizontal tube *ae* of even bore, a ball *dge* of a large diameter, and a ſwan-neck tube *bf*. Let the ball and part of the tube *geb* be filled with mercury, ſo that the tube may be in the ſame horizontal plane with the ſurface *de* of the mercury in the ball. Then ſeal up the end *a*, and connect *f* with an air pump. When the air is abſtracted from the ſurface *de*, the air in *ab* will expand into a larger bulk *ac*, and the mercury in the pump-gage will riſe to ſome diſtance below the barometric height. It is evident that this diſtance, without any farther calculation, will be the meaſure of the elaſticity of the air preſſing on the ſurface *de*, and therefore of the air in *ac*.

210
The moſt exact mode of examining this elaſticity.

The moſt exact of all methods is to ſuſpend in the receiver of an air-pump a glaſs veſſel, having a very narrow mouth over a ciſtern of mercury, and then abſtract the air till the gage riſes to ſome determined height. The difference *e* between this height and the barometric height determines the elaſticity of the air in the receiver and in the ſuſpended veſſel. Now lower down that veſſel by the ſlip-wire till its mouth is immerſed into the mercury, and admit the air into the receiver; it will preſs the mercury into the little veſſel. Lower it ſtill farther down, till the mercury within it is level with that without; then ſtop its mouth, take it out and weigh the mercury, and let its weight be *w*. Subtract this weight from the weight *v* of the mercury, which would completely fill the whole veſſel; then the natural bulk of the air will be $v-w$, while its bulk, when of the elaſticity *e* in the rarefied receiver, was the bulk or capacity *w* of the veſſel. Its denſity therefore, correſponding to this elaſticity *e*, was $\frac{v-w}{w}$. And thus may the relation between the denſity and elaſticity in all caſes be obtained.

211
Various experiments have been made to this purpoſe.

A great variety of experiments to this purpoſe have been made, with different degrees of attention, according to the intereſt which the philoſophers had in the reſult. Thoſe made by M. de Luc, General Roy, Mr Trembley, and Sir George Shuckbourgh, are by far the moſt accurate; but they are all confined to very moderate rarefactions. The general reſult has been, that the elaſticity of rarefied air is very nearly proportional to its denſity. We cannot ſay with confidence that any regular deviation from this law has been obſerved, there being as many obſervations on one ſide as on the other; but we think that it is not unworthy the attention of philoſophers to determine it with preciſion in the caſes of extreme rarefaction, where the irregularities are moſt remarkable. The great ſource of error is a certain adheſive ſluggiſhneſs of the mercury when the impelling forces are very ſmall; and other fluids can hardly be uſed, becauſe they either ſmear the inſide of the tube and diminiſh its capacity, or they are converted into vapour, which alters the law of elaſticity.

212
The Boylean law may in general be aſſumed.

Let us, upon the whole, aſſume the Boylean law, *viz.* that the elaſticity of the air is proportional to its denſity. The law deviates not in any ſenſible degree from the truth in thoſe caſes which are of the greateſt practical importance, that is, when the denſity does not much exceed or fall ſhort of that of ordinary air.

213
Inveſtigation of the action of the particles on each other.

Let us now ſee what information this gives us with reſpect to the action of the particles on each other.

The inveſtigation is extremely eaſy. We have ſeen that a force eight times greater than the preſſure of the atmoſphere will compreſs common air into the eighth part of its common bulk, and give it eight times its common denſity: and in this caſe we know, that the particles are at half their former diſtance, and that the number which are now acting on the ſurface of the piſton employed to compreſs them is quadruple of the number which act on it when it is of the common denſity. Therefore, when this eightfold compreſſing force is diſtributed over a fourfold number of particles, the portion of it which acts on each is double. In like manner, when a compreſſing force 27 is employed, the air is compreſſed into $\frac{1}{27}$ of its former bulk, the particles are at $\frac{1}{3}$ of their former diſtance, and the force is diſtributed among 9 times the number of particles; the force on each is therefore 3. In ſhort, let $\frac{1}{x}$ be the diſtance of the particles, the number of them in any given veſſel, and therefore the denſity will be as x^3, and the number preſſing by their elaſticity on its whole internal ſurface will be as x^2. Experiment ſhows, that the compreſſing force is as x^3, which being diſtributed over the number as x^2, will give the force on each as *x*. Now this force is in immediate equilibrium with the elaſticity of the particle immediately contiguous to the compreſſing ſurface. This elaſticity is therefore as *x*: and it follows from the nature of perfect fluidity, that the particle adjoining to the compreſſing ſurface preſſes with an equal force on its adjoining particles on every ſide. Hence we muſt conclude, that the corpuſcular repulſions exerted by the adjoining particles are inverſely as their diſtances from each other, or that the adjoining particles tend to recede from each other with forces inverſely proportional to their diſtances.

214
Sir Iſaac Newton was the firſt who reaſoned properly on this ſubject.

Sir Iſaac Newton was the firſt who reaſoned in this manner from the phenomena. Indeed he was the firſt who had the patience to reflect on the phenomena with any preciſion. His diſcoveries in gravitation naturally gave his thoughts this turn, and he very early hinted his ſuſpicions that all the characteriſtic phenomena of tangible

Boylean Law.

tangible matter were produced by forces which were exerted by the particles at ſmall and inſenſible diſtances: And he conſiders the phenomena of air as affording an excellent example of this inveſtigation, and deduces from them the law which we have now demonſtrated; and ſays, that air conſiſts of particles which avoid the adjoining particles with forces inverſely proportional to their diſtances from each other. From this he deduces (in the 2d book of his Principles) ſeveral beautiful propoſitions, determining the mechanical conſtitution of the atmoſphere.

215 Limits the action to adjoining particles.

But it muſt be noticed that he limits this action to the *adjoining* particles: and this is a remark of immenſe conſequence, though not attended to by the numerous experimenters who adopt the law.

It is plain that the particles are ſuppoſed to act at a diſtance, and that this diſtance is variable, and that the forces diminiſh as the diſtances increaſe. A very ordinary air-pump will rarefy the air 125 times. The diſtance of the particles is now 5 times greater than before; and yet they ſtill repel each other: for air of this denſity will ſtill ſupport the mercury in a ſyphon-gage at the height of 0,24, or $\frac{24}{100}$ of an inch; and a better pump will allow this air to expand twice as much, and ſtill leave it elaſtic. Thus we ſee that whatever is the diſtance of the particles of common air, they can act five times farther off. The queſtion comes now to be, Whether, in the ſtate of common air, they really do act five times farther than the diſtance of the adjoining particles? While the particle *a* acts on the particle *b* with the force 5, does it alſo act on the particle *c* with the force 2, 5, on the particle *d* with the force 1,667, on the particle *e* with the force 1,25, on the particle *f* with the force 1, on the particle *g* with the force 0,8333, &c.?

216 Sir Iſaac Newton ſhows in the plaineſt manner, that this is by no means the caſe; for if this were the caſe, he makes it appear that the ſenſible phenomena of condenſation would be totally different from what we obſerve. The force neceſſary for a quadruple condenſation would be eight times greater, and for a nonuple condenſation the force muſt be 27 times greater. Two ſpheres filled with condenſed air muſt repel each other, and two ſpheres containing air that is rarer than the ſurrounding air muſt attract each other, &c. &c. All this will appear very clearly, by applying to air the reaſoning which Sir Iſaac Newton has employed in deducing the ſenſible law of mutual tendency of two ſpheres, which conſiſt of particles attracting each other with forces proportional to the ſquare of the diſtance inverſely.

217 If we could ſuppoſe that the particles of air repelled each other with invariable forces at all diſtances within ſome ſmall and inſenſible limit, this would produce a compreſſibility and elaſticity ſimilar to what we obſerve. For if we conſider a row of particles, within this limit, as compreſſed by an external force applied to the two extremities, the action of the whole row on the extreme points would be proportional to the number of particles, that is, to their diſtance inverſely and to their denſity: and a number of ſuch parcels, ranged in a ſtraight line, would conſtitute a row of any ſenſible magnitude having the ſame law of compreſſion. But this law of corpuſcular force is unlike every thing we obſerve in nature, and to the laſt degree improbable.

Height of the Atmoſphere.

218 We muſt therefore continue the limitation of this mutual repulſion of the particles of air, and be contented for the preſent with having eſtabliſhed it as an experimental fact, that the *adjoining* particles of air are kept aſunder by forces inverſely proportional to their diſtances; or perhaps it is better to abide by the ſenſible law, that *the denſity of air is proportional to the compreſſing force*. This law is abundantly ſufficient for explaining all the ſubordinate phenomena, and for giving us a complete knowledge of the mechanical conſtitution of our atmoſphere.

219 The height of the air inveſtigated from conſidering its compreſſibility, &c.

And, in the firſt place, this view of the compreſſibility of the air muſt give us a very different notion of the height of the atmoſphere from what we deduced on a former occaſion from our experiments. It is found, that when the air is of the temperature 32° of Fahrenheit's thermometer, and the mercury in the barometer ſtands at 30 inches, it will deſcend one-tenth of an inch if we take it to a place 87 feet higher. Therefore, if the air were equally denſe and heavy throughout, the height of the atmoſphere would be 30×10×87 feet, or 5 miles and 100 yards. But the looſe reaſoning adduced on that occaſion was enough to ſhow us that it muſt be much higher; becauſe every ſtratum as we aſcend muſt be ſucceſſively rarer as it is leſs compreſſed by incumbent weight. Not knowing to what degree air expanded when the compreſſion was diminiſhed, we could not tell the ſucceſſive diminutions of denſity and conſequent augmentation of bulk and height; we could only ſay, that ſeveral atmoſpheric appearances indicated a much greater height. Clouds have been ſeen much higher; but the phenomenon of the twilight is the moſt convincing proof of this. There is no doubt that the viſibility of the ſky or air is owing to its want of perfect tranſparency, each particle (whether of matter purely aerial or heterogeneous) reflecting a little light.

220 Plate CCCCIV.

Let *b* (fig. 54.) be the laſt particle of illuminated air which can be ſeen in the horizon by a ſpectator at A. This muſt be illuminated by a ray SD *b*, touching the earth's ſurface at ſome point D. Now it is a known fact, that the degree of illumination called *twilight* is perceived when the ſun is 18° below the horizon of the ſpectator, that is, when the angle E *b* S or ACD is 18 degrees; therefore *b* C is the ſecant of 9 degrees (it is leſs, viz. about 8½ degrees on account of refraction). We know the earth's radius to be about 3970 miles: hence we conclude *b* B to be about 45 miles; nay, a very ſenſible illumination is perceptible much farther from the ſun's place than this, perhaps twice as far, and the air is ſufficiently denſe for reflecting a ſenſible light at the height of nearly 200 miles.

221 Experiment fixes no limit to the air's expanſibility.

We have now ſeen that air is prodigiouſly expanſible. None of our experiments have diſtinctly ſhown us any limit. But it does not follow that it is expanſible without end; nor is this at all likely. It is much more probable that there is a certain diſtance of the parts in which they no longer repel each other; and this would be the diſtance at which they would arrange themſelves if they were not heavy. But at the very ſummit of the atmoſphere they will be a very ſmall matter nearer to each other, on account of their gravitation to the earth. Till we know preciſely the law of this mutual repulſion, we cannot ſay what is the height of the atmoſphere.

But if the air be an elaſtic fluid whoſe denſity is always

ways proportionable to the compreſſing force, we can tell what is its denſity at any height above the ſurface of the earth: and we can compare the denſity ſo calculated with the denſity diſcovered by obſervation: for this laſt is meaſured by the height at which it ſupports mercury in the barometer. This is the direct meaſure of the preſſure of the external air; and as we know the law of gravitation, we can tell what would be the preſſure of air having the calculated denſity in all its parts.

222 Farther obſervations on, and inveſtigation of, the height of the atmoſphere.

223 Let us therefore ſuppoſe a priſmatic or cylindric column of air reaching to the top of the atmoſphere. Let this be divided into an indefinite number of ſtrata of very ſmall and equal depths or thickneſs; and let us, for greater ſimplicity, ſuppoſe at firſt that a particle of air is of the ſame weight at all diſtances from the centre of the earth.

224 The abſolute weight of any one of theſe ſtrata will on theſe conditions be proportional to the number of particles or the gravity of air contained in it; and ſince the depth of each ſtratum is the ſame, this quantity of air will evidently be as the denſity of the ſtratum: but the denſity of any ſtratum is as the compreſſing force; that is, as the preſſure of the ſtrata above it; that is, as their weight; that is, as their quantity of matter—therefore the quantity of air in each ſtratum is proportional to the quantity of air above it; but the quantity in each ſtratum is the difference between the column incumbent on its bottom and on its top: theſe differences are therefore proportional to the quantities of which they are the differences. But when there is a ſeries of quantities which are proportional to their own differences, both the quantities and their differences are in continual or geometrical progreſſion: for let *a*, *b*, *c*, be three ſuch quantities that

$b : c = a - b : b - c$, then, by altern.

$b : a - b = c : b - c$ and by compoſ.

$b : a = c : b$

and $a : b = b : c$

therefore the denſities of theſe ſtrata decreaſe in a geometrical progreſſion; that is, when the elevations above the centre or ſurface of the earth increaſe, or their depths under the top of the atmoſphere, decreaſe, in an arithmetical progreſſion, the denſities decreaſe in a geometrical progreſſion.

225 Plate CCCCIV. Let ARQ (fig. 55.) repreſent the ſection of the earth by a plane through its centre O, and let *m* OAM be a vertical line, and AE perpendicular to OA will be a horizontal line through A, a point on the earth's ſurface. Let AE be taken to repreſent the denſity of the air at A; and let DH, parallel to AE, be taken to AE as the denſity at D is to the denſity at A: it is evident, that if a logiſtic or logarithmic curve EHN be drawn, having AN for its axis, and paſſing through the points E and H, the denſity of the air at any other point C, in this vertical line, will be repreſented by CG, the ordinate to the curve in that point: for it is the property of this curve, that if portions AB, AC, AD, of its axis be taken in arithmetical progreſſion, the ordinates AE, BF, CG, DH, will be in geometrical progreſſion.

226 It is another fundamental property of this curve, that if EK or HS touch the curve in E or H, the ſubtangent AK or DS is a conſtant quantity.

227 And a third fundamental property is, that the infinitely extended area MAEN is equal to the rectangle KAEL of the ordinate and ſubtangent; and, in like manner, the area MDHN is equal to SD×DH, or to KA×DH; conſequently the area lying beyond any ordinate is proportionable to that ordinate.

228 Theſe geometrical properties of this curve are all analogous to the chief circumſtances in the conſtitution of the atmoſphere, on the ſuppoſition of equal gravity. The area MCGN repreſents the whole quantity of aereal matter which is above C: for CG is the denſity at C, and CD is the thickneſs of the ſtratum between C and D; and therefore CGHD will be as the quantity of matter or air in it; and in like manner of all the others, and of their ſums, or the whole area MCGN: and as each ordinate is proportional to the area above it, ſo each denſity, and the quantity of air in each ſtratum, is proportional to the quantity of air above it: and as the whole area MAEN is equal to the rectangle KAEL, ſo the whole air of variable denſity above A might be contained in a column KA, if, inſtead of being compreſſed by its own weight, it were without weight, and compreſſed by an external force equal to the preſſure of the air at the ſurface of the earth. In this caſe, it would be of the uniform denſity AE, which it has at the ſurface of the earth, making what we have repeatedly called the homogeneous atmoſphere.

229 Hence we derive this important circumſtance, that the height of the homogeneous atmoſphere is the ſubtangent of that curve whoſe ordinates are as the denſities of the air at different heights, on the ſuppoſition of equal gravity. This curve may with propriety be called the ATMOSPHERICAL LOGARITHMIC: and as the different logarithmics are all characteriſed by their ſubtangents, it is of importance to determine this one.

It may be done by comparing the denſities of mercury and air. For a column of air of uniform denſity, reaching to the top of the homogeneous atmoſphere, is in equilibrio with the mercury in the barometer. Now it is found, by the beſt experiments, that when mercury and air are of the temperature 32° of Fahrenheit's thermometer, and the barometer ſtands at 30 inches, the mercury is nearly 10440 times denſer than air. Therefore the height of the homogeneous atmoſphere is 10440 times 30 inches, or 26100 feet, or 8700 yards, or 4350 fathoms, or five miles wanting 100 yards.

230 Or it may be found by obſervations on the barometer. It is found, that when the mercury and air are of the above temperature, and the barometer on the ſea-ſhore ſtands at 30 inches, if we carry it to a place 884 feet higher it will fall to 29 inches. Now, in all logarithmic curves having equal ordinates, the portions of the axes intercepted between the correſponding pairs of ordinates are proportional to the ſubtangents. And the ſubtangents of the curve belonging to our common tables is 0,4342945, and the difference of the logarithms of 30 and 29 (which is the portion of the axis intercepted between the ordinates 30 and 29), or 0,0147233, is to 0,4342945 as 883 is to 26058 feet, or 8686 yards, or 4343 fathoms, or 5 miles wanting 114 yards. This determination is 14 yards leſs than the other, and it is uncertain which is the moſt exact. It is extremely difficult to meaſure the reſpective denſities of mercury and air; and in meaſuring the elevation which pro-

duces a fall of one inch in the barometer, an error of $\frac{1}{10}$ of an inch would produce all the difference. We prefer the laſt, as depending on fewer circumſtances.

231 But all this inveſtigation proceeds on the ſuppoſition of equal gravity, whereas we know that the weight of a particle of air decreaſes as the ſquare of its diſtance from the centre of the earth increaſes. In order, therefore, that a ſuperior ſtratum may produce an equal preſſure at the ſurface of the earth, it muſt be denſer, becauſe a particle of it gravitates leſs. The denſity, therefore, at equal elevations, muſt be greater than on the ſuppoſition of equal gravity, and the law of diminution of denſity muſt be different.

Make $OD : OA = OA : Od$;
$OC : OA = OA : Oc$;
$OB : OA = OA : Ob$, &c;

ſo that Od, Oc, Ob, OA, may be reciprocals to OD, OC, OB, OA; and through the points A, b, c, d, draw the perpendiculars AE, bf, cg, dh, making them proportional to the denſities in A, B, C, D: and let us ſuppoſe CD to be exceedingly ſmall, ſo that the denſity may be ſuppoſed uniform through the whole ſtratum. Thus we have

$$OD \times Od = OA^2, = OC \times Oc$$
and $Oc : Od = OD : OC$;
and $Oc : Oc - Od = OD : OD - OC$,
or $Oc : cd = OD : DC$;
and $cd : CD = Oc : OD$;

or, becauſe OC and OD are ultimately in the ratio of equality, we have

$$cd : CD = Oc : OC = OA^2, : OC^2,$$

and $cd = CD \times \frac{OA^2}{OC^2}$, and $cd \times cg = CD \times cg \times \frac{OA^2}{OC^2}$;

but $CD \times cg \times \frac{OA^2}{OC^2}$ is as the preſſure at C ariſing from the abſolute weight of the ſtratum CD. For this weight is as the bulk, as the denſity, and as the gravitation of each particle jointly. Now CD expreſſes the bulk, cg the denſity, and $\frac{OA^2}{OC^2}$ the gravitation of each particle. Therefore, $cd \times cg$ is as the preſſure on C ariſing from the weight of the ſtratum DC; but $cd \times cg$ is evidently the element of the curvilineal area A$mn$E, formed by the curve E$fghn$ and the ordinates AE, bf, cg, ah, &c. mn. Therefore the ſum of all the elements, ſuch as $cdhg$, that is, the area $cmng$ below cg, will be as the *whole* preſſure on C, ariſing from the gravitation of all the air above it; but, by the nature of air, this whole preſſure is as the denſity which it produces, that is, as cg. Therefore the curve Egn is of ſuch a nature that the area lying below or beyond any ordinate cg is proportional to that ordinate. This is the property of the logarithmic curve, and Egn is a logarithmic curve.

232 But farther, this curve is the ſame with EGN. For let B continually approach to A, and ultimately coincide with it. It is evident that the ultimate ratio of BA to Ab, and of BF to bf, is that of equality; and if EFK, Efk, be drawn they will contain equal angles with the ordinate AE, and will cut off equal ſubtangents AK, Ak. The curves EGN, Egn are therefore the ſame, but in oppoſite poſitions.

233 Laſtly, if OA, Ob, Oc, Od, &c. be taken in arithmetical progreſſion decreaſing, their reciprocals OA, OB, OC, OD, &c. will be in harmonical progreſſion increaſing, as is well known: but from the nature of the logarithmic curve, when OA, Ob, Oc, Od, &c. are in arithmetical progreſſion, the ordinates AE, bf, cg, dh, &c. are in geometrical progreſſion. Therefore when OA, OB, OC, OD, &c. are in harmonical progreſſion, the denſities of the air at A, B, C, D, &c. are in geometrical progreſſion; and thus may the denſity of the air at all elevations be diſcovered. Thus to find the denſity of the air K the top of the homogeneous atmoſphere, make $OK : OA = OA : OL$, and draw the ordinate LT, LT is the denſity at K.

The celebrated Dr Halley was the firſt who obſerved the relation between the denſity of the air and the ordinates of the logarithmic curve, or common logarithms. This he did on the ſuppoſition of equal gravity; and his diſcovery is acknowledged by Sir Iſaac Newton in *Princip.* ii. *prop.* 22. *ſchol.* Halley's diſſertation on the ſubject is in n° 185 of the Phil. Tranſ. Newton, with his uſual ſagacity, extended the ſame relation to the true ſtate of the caſe, where gravity is as the ſquare of the diſtance inverſely; and ſhowed that when the diſtances from the earth's centre are in harmonic progreſſion, the denſities are in geometric progreſſion. He ſhows indeed, in general, what progreſſion of the diſtance, on any ſuppoſition of gravity, will produce a geometrical progreſſion of the denſities, ſo as to obtain a ſet of lines OA, Ob, Oc, Od, &c. which will be logarithms of the denſities. The ſubject was afterwards treated in a more familiar manner by Cotes in his *Hydroſt. Lect.* and in his *Harmonia Menſurarum;* alſo by Dr Brooke Taylor, *Meth. Increment;* Wolf in his *Acrometria;* Herman in his *Phoronomia;* &c. &c. and lately by Horſley, Phil. Tranſ. tom. lxiv.

234 The air has a finite denſity at an infinite diſtance from the centre of the earth.

An important corollary is deducible from theſe principles, viz. that the air has a finite denſity at an infinite diſtance from the centre of the earth, namely, ſuch as will be repreſented by the ordinate OP drawn through the centre. It may be objected to this concluſion, that it would infer an infinity of matter in the univerſe, and that it is inconſiſtent with the phenomena of the planetary motions, which appear to be performed in a ſpace void of all reſiſtance, and therefore of all matter. But this fluid muſt be ſo rare at great diſtances, that the reſiſtance will be inſenſible, even though the retardation occaſioned by it has been accumulated for ages. Even at the very moderate diſtance of 500 miles, the rarity is ſo great that a cubic inch of common air expanded to that degree would occupy a ſphere equal to the orbit of Saturn; and the whole retardation which this plane would ſuſtain after ſome millions of years would not exceed what would be occaſioned by its meeting one bit of matter of half a grain weight.

This being the caſe, it is not unreaſonable to ſuppoſe the viſible univerſe occupied by air, which, by its gravitation, will accumulate itſelf round every body in it, in a proportion depending on their quantities of matter, the larger bodies attracting more of it than the ſmaller ones, and thus forming an atmoſphere about each. And many appearances warrant this ſuppoſition. Jupiter, Mars, Saturn, and Venus, are evidently ſurrounded by atmoſpheres. The conſtitution of theſe atmoſpheres may differ exceedingly from other cauſes. If the planet has nothing on its ſurface which can be diſſolved by the air or volatiliſed by heat, the atmoſphere will be continually clear and tranſparent, like that of the moon.

235 The atmoſphere of Mars,

Mars has an atmoſphere which appears preciſely like our own, carrying clouds, or depoſiting ſnows: for when, by the obliquity of his axis to the plane of his ecliptic, he turns his north pole towards the ſun, it is obſerved to be occupied by a broad white ſpot. As the ſummer of that region advances, this ſpot gradually waſtes, and ſometimes vaniſhes, and then the ſouth pole comes in ſight, ſurrounded in like manner with a white ſpot, which undergoes ſimilar changes. This is preciſely the appearance which the ſnowy circumpolar regions of this earth will exhibit to an aſtronomer on Mars. It may not, however, be ſnow that we ſee; thick clouds will have the ſame appearances.

236 Of Jupiter,

The atmoſphere of the planet Jupiter is alſo very ſimilar to our own. It is diverſified by ſtreaks or belts parallel to his equator, which frequently change their appearance and dimenſions, in the ſame manner as thoſe tracks of ſimilar ſky which belong to different regions of this globe. There is a certain kind of weather that more properly belongs to a particular climate than to any other. This is nothing but a certain general ſtate of the atmoſphere which is prevalent there, though with conſiderable variations. This muſt appear to a ſpectator in the moon like a ſtreak ſpread over that climate, diſtinguiſhing it from others. But the moſt remarkable ſimilarity is in the motion of the clouds on Jupiter. They have plainly a motion from eaſt to weſt relative to the body of the planet: for there is a remarkable ſpot on the ſurface of the planet, which is obſerved to turn round the axis in 9h. 51′ 16″; and there frequently appear variable and periſhing ſpots in the belts, which ſometimes laſt for ſeveral revolutions. Theſe are obſerved to circulate in 9. 55. 05. Theſe numbers are the reſults of a long ſeries of obſervations by Dr Herſchel. This plainly indicates a general current of the clouds weſtward, preciſely ſimilar to what a ſpectator in the moon muſt obſerve in our atmoſphere ariſing from the trade-winds. Mr Schroeter has made the atmoſphere of Jupiter a ſtudy for many years; and deduces from his obſervations that the motion of the variable ſpots is ſubject to great variations, but is always from eaſt to weſt. This indicates variable winds.

237 Of Venus,

The atmoſphere of Venus appears alſo to be like ours, loaded with vapours, and in a ſtate of continual change of abſorption and precipitation. About the middle of laſt century the ſurface of Venus was pretty diſtinctly ſeen for many years chequered with irregular ſpots which are deſcribed by Campani, Bianchini, and other aſtronomers in the ſouth of Europe, and alſo by Caſſini at Paris, and Hooke and Towley in England. But the ſpots became gradually more faint and indiſtinct; and, for near a century, have diſappeared. The whole ſurface appears now of one uniform brilliant white. The atmoſphere is probably filled with a reflecting vapour, thinly diffuſed through it, like water faintly tinged with milk. A great depth of this muſt appear as white as a ſmall depth of milk itſelf; and it appears to be of a *very great* depth, and to be refractive like our air. For Dr Herſchel has obſerved, by the help of his fine teleſcopes, that the illuminated part of Venus is conſiderably more than a hemiſphere, and that the light dies gradually away to the bounding margin. This is the very appearance that the earth would make if furniſhed with ſuch an atmoſphere. The boundary of illumination would have a penumbra reaching about nine degrees beyond it. If this be the conſtitution of the atmoſphere of Venus, ſhe may be inhabited by beings like ouſelves. They would not be dazzled by the intolerable ſplendor of a ſun four times as big and as bright, and ſixteen times more glaring, than ours; for they would ſeldom or never ſee him, but inſtead of him an uniformly bright and white ſky. They would probably never ſee a ſtar or planet, unleſs the dog-ſtar and Mercury; and perhaps the earth might pierce through the bright haze which ſurrounds their planet. For the ſame reaſon the inhabitants would not perhaps be incommoded by the ſun's heat. It is indeed a very queſtionable thing, whether the ſun would cauſe any heat, even here, if it were not for the chemical action of his rays on our air. This is rendered not improbable by the intenſe cold felt on the tops of the higheſt mountains, in the cleareſt air, and even under a vertical ſun in the torrid zone.

238 And of comets;

The atmoſphere of comets ſeems of a nature totally different. This ſeems to be of inconceivable rarity, even when it reflects a very ſenſible light. The tail is always turned nearly away from the ſun. It is thought that this is by the impulſe of the ſolar rays. If this be the caſe, we think it might be diſcovered by the aberration and the refraction of the light by which we ſee the tail: for this light muſt come to our eye with a much ſmaller velocity than the ſun's light, if it be reflected by repulſive or elaſtic forces, which there is every reaſon in the world to believe; and therefore the velocity of the reflected light will be diminiſhed by all the velocity communicated to the reflecting particles. This is almoſt inconceivably great. The comet of 1680 went half round the ſun in ten hours, and had a tail at leaſt a hundred millions of miles long, which turned round at the ſame time, keeping nearly in the direction oppoſite to the ſun. The velocity neceſſary for this is prodigious, approaching to that of light. And perhaps the tail extends much farther than we ſee it, but is viſible only as far as the velocity with which its particles recede from the ſun is leſs than a certain quantity, namely, what would leave a ſufficient velocity for the reflected light to enable it to affect our eyes. And it may be demonſtrated, that although the real form of the viſible tail is concave on the anterior ſide to which the comet is moving, it may appear convex on that ſide, in conſequence of the very great aberration of the light by which the remote parts are ſeen. All this may be diſcovered by properly contrived obſervations; and the conjecture merits attention. But of this digreſſion there is enough; and we return to our ſubject, the conſtitution of our air.

239 The barometer uſed in taking heights.

We have ſhown how to determine *à priori* the denſity of the air at different elevations above the ſurface of the earth. But the denſities may be diſcovered in all acceſſible elevations by experiments; namely, by obſerving the heights of the mercury in the barometer. This is a direct meaſure of the preſſure of the incumbent atmoſphere; and this is proportional to the denſity which it produces.

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Therefore, by means of the relation ſubſiſting between the denſities and the elevations, we can diſcover the elevations by obſervations made on the denſities by means of the barometer; and thus we may meaſure elevations by means of the barometer; and, with very little trouble, take the level of any extenſive track of country. Of this we have an illuſtrious example in the ſection which the Abbé Chappe D' Auteroche has given of the whole country between Breſt and Ekaterinenburgh in Siberia. This is a ſubject which deſerves a minute conſideration: we ſhall therefore preſent it under a very ſimple and familiar form; and trace the method through its various ſteps of improvement by De Luc, Roy, Shuckbourgh, &c.

241 Explanation of its uſe, &c.

We have already obſerved oſtener than once, that if the mercury in the barometer ſtands at 30 inches, and if the air and mercury be of the temperature 32° in Fahrenheit's thermometer, a column of air 87 feet thick has the ſame weight with a column of mercury $\frac{1}{10}$ of an inch thick. Therefore, if we carry the barometer to a higher place, ſo that the mercury ſinks to 29.9, we have aſcended 87 feet. Now, ſuppoſe we carry it ſtill higher, and that the mercury ſtands at 29.8; it is required to know what height we have now got to? We have evidently aſcended through another ſtratum of equal weight with the former: but it muſt be of greater thickneſs, becauſe the air in it is rarer, being leſs compreſſed. We may call the denſity of the firſt ſtratum 300, meaſuring the denſity by the number of tenths of an inch of mercury which its elaſticity proportional to its denſity enables it to ſupport. For the ſame reaſon, the denſity of the ſecond ſtratum muſt be 299: but when the weights are equal, the bulks are inverſely as the denſities; and when the baſes of the ſtrata are equal, the bulks are as the thickneſſes. Therefore, to obtain the thickneſs of this ſecond ſtratum, ſay 299:300=87:87,29; and this fourth term is the thickneſs of the ſecond ſtratum, and we have aſcended in all 174,29 feet. In like manner we may riſe till the barometer ſhows the denſity to be 298: then ſay, 298 : 30=87 : 87,584 for the thickneſs of the third ſtratum, and 261,875 or 261$\frac{7}{8}$ for the whole aſcent; and we may proceed in the ſame way for any number of mercurial heights, and make a table of the correſponding elements as follow; where the firſt column is the height of the mercury in the barometer, the ſecond column is the thickneſs of the ſtratum, or the elevation above the preceding ſtation; and the third column is the whole elevation above the firſt ſtation.

Bar.	Strat.	Elev.
30	00,000	00,000
29,9	87,000	87,000
29,8	87,291	174,291
29,7	87,584	261,875
29,6	87,879	349,754
29,5	88,176	437,930
29,4	88,475	526,405
29,3	88,776	615,181
29,2	89,079	704,260
29,1	89,384	793,644
29	89,691	883,335

242 Having done this, we can now meaſure any elevation within the limits of our table, in this manner.

Obſerve the barometer at the lower and at the upper ſtations, and write down the correſponding elevations. Subtract the one from the other, and the remainder is the height required. Thus ſuppoſe that at the lower ſtation the mercurial height was 29,8, and that at the upper ſtation it was 29,1.

$$\begin{array}{ll} 29,1 & 793,644 \\ 29,8 & \underline{174,291} \\ & 619,353=\text{Elevation.} \end{array}$$

We may do the ſame thing with tolerable accuracy without the table, by taking the medium m of the mercurial heights, and their difference d in tenths of an inch; and then ſay, as m to 300, ſo is 87 d to the height required h: or $h=\frac{300\times 87\,d}{m}=\frac{26100\,d}{m}$. Thus, in the foregoing example, m is 294,5, and d is=7; and therefore $h=\frac{7\times 26100}{294,5}=620,4$, differing only one foot from the former value.

Either of theſe methods is ſufficiently accurate for moſt purpoſes, and even in very great elevations will not produce any error of conſequence: the whole error of the elevation 883 feet 4 inches which is the extent of the above table, is only $\frac{3}{4}$ of an inch.

243 But we need not confine ourſelves to methods of approximation, when we have an accurate and ſcientific method that is equally eaſy. We have ſeen that, upon the ſuppoſition of equal gravity, the denſities of the air are as the ordinates of a logarithmic curve, having the line of elevations for its axis. We have alſo ſeen that, in the true theory of gravity, if the diſtances from the centre of the earth increaſe in a harmonic progreſſion, the logarithm of the denſities will decreaſe in an arithmetical progreſſion; but if the greateſt elevation above the ſurface be but a few miles, this harmonic progreſſion will hardly differ from an arithmetical one. Thus, if Ab, Ac, Ad, are 1, 2, and 3 miles, we ſhall find that the correſponding elevations AB, AC, AD are ſenſibly in arithmetical progreſſion alſo: for the earth's radius AC is nearly 4000 miles. Hence it plainly follows, that BC—AB is $\frac{1}{4000\times 4001}$, or $\frac{1}{16004000}$ of a mile, or $\frac{1}{250}$ of an inch; a quantity quite inſignificant. We may therefore affirm without heſitation, that in all acceſſible places, the elevations increaſe in an arithmetical progreſſion, while the denſities decreaſe in a geometrical progreſſion. Therefore the ordinates are proportional to the numbers which are taken to meaſure the denſities, and the portions of the axis are proportional to the logarithms of theſe numbers. It follows, therefore, that we may take ſuch a ſcale for meaſuring the denſities that the logarithms of the numbers of this ſcale ſhall be the very portions of the axis; that is of the vertical line in feet, yards, fathoms, or what meaſure we pleaſe: and we may, on the other hand, chooſe ſuch a ſcale for meaſuring our elevations, that the logarithms of our ſcale of denſities ſhall be parts of this ſcale of elevations; and we may find either of theſe ſcales ſcientifically. For it is a known property of the logarithmic curves, that when the ordinates are the ſame, the intercepted portions of the abſciſſæ are proportional to their ſubtangents. Now we know the ſubtangent of the atmoſpherical logarithmic: it is the height of the homogeneous atmoſphere in any meaſure we pleaſe, ſuppoſe fathoms: we find this height by comparing the gravities of air and mercury, when

both are of ſome determined denſity. Thus, in the temperature of 32° of Fahrenheit's thermometer, when the barometer ſtands at 30 inches, it is known (by many experiments) that mercury is 10423,068 times heavier than air; therefore the height of the balancing column of homogeneous air will be 10423,068 times 30 inches; that is 4342,945 Engliſh fathoms. Again, it is known that the ſubtangent of our common logarithmic tables, where 1 is the logarithm of the number 10, is 0,4342945. Therefore the number 0,4342945 is to the difference D of the logarithms of any two barometric heights as 4342,945 fathoms are to the fathoms F contained in the portion of the axis of the atmoſpherical logarithmic, which is intercepted between the ordinates equal to theſe barometrical heights; or that 0,4342945 : D =4342,945 : F, and 0,4342,945 : 4342,945=D : F; but 0,4342945 is the ten-thouſandth part of 4342,945, and therefore D is the ten-thouſandth part of F.

244 And thus it happens by mere chance, that the logarithms of the denſities, meaſured by the inches of mercury which their elaſticity ſupports in the barometer, are juſt the ten-thouſandth part of the fathoms contained in the correſponding portions of the axis of the atmoſpherical logarithmic. Therefore, if we multiply our common logarithms by 10000, they will expreſs the fathoms of the axis of the atmoſpherical logarithmic; nothing is more eaſily done. Our logarithms contain what is called the index or characteriſtic, which is an integer and a number of decimal places. Let us juſt remove the integer-place four figures to the right hand: thus the logarithm of 60 is 1.7781513, which is one integer and $\frac{7781513}{10000000}$. Multiply this by 10,000, and we obtain $\frac{513}{1001}$ 17781,513, or 17781 $\frac{513}{1000}$.

245 The practical application of all this reaſoning is obvious and eaſy: obſerve the heights of the mercury in the barometer at the upper and lower ſtations in inches and decimals; take the logarithms of theſe, and ſubtract the one from the other: the difference between them (accounting the four firſt decimal figures as integers) is the difference of elevation of fathoms.

Example.

Merc. Height at the lower ſtation	29,8	1.4742163
upper ſtation	29,1	1.4638930
Diff. of Log. × 10000		0.0103,233

or 103 fathoms and $\frac{233}{1000}$ of a fathom, which is 619,392 feet, or 619 feet $4\frac{3}{4}$ inches; differing from the approximated value formerly found about $\frac{1}{4}$ an inch.

246 This method of meaſuring heights now much improved.

Such is the general nature of the barometric meaſurement of heights firſt ſuggeſted by Dr Halley; and it has been verified by numberleſs compariſons of the heights calculated in this way with the ſame height meaſured geometrically. It was indeed in this way that the preciſe ſpecific gravity of air and mercury was moſt accurately determined; namely, by obſerving, that when the temperature of air and mercury was 32, the difference of the logarithms of the mercurial heights were preciſely the fathoms of elevation. But it requires many corrections to adjuſt this method to the circumſtances of the caſe; and it was not till very lately that it has been ſo far adjuſted to them as to become uſeful. We are chiefly indebted to Mr de Luc for the improvements. The great elevations in Switzerland enabled him to make an immenſe number of obſervations, in almoſt every variety of circumſtances. Sir George Shuckbourgh alſo made a great number with moſt accurate inſtruments in much greater elevations, in the ſame country; and he made many chamber experiments for determining the laws of variation in the ſubordinate circumſtances. General Roy alſo made many to the ſame purpoſe. And to theſe two gentlemen we are chiefly obliged for the corrections which are now generally adopted.

247 It depends on the ſpecific gravity of air and mercury.

It is eaſy to perceive that the method, as already expreſſed, cannot apply to every caſe: it depends on the ſpecific gravity of air and mercury, combined with the ſuppoſition that this is affected *only by a change of preſſure*. But ſince all bodies are expanded by heat, and as there is no reaſon to ſuppoſe that they are equally expanded by it, it follows that a change of temperature will change the relative gravity of mercury and air, even although both ſuffer the ſame change of temperature: and ſince the air may be warmed or cooled when the mercury is not, or may change its temperature independent of it, we may expect ſtill greater variations of ſpecific gravity.

The general effect of an augmentation of the ſpecific gravity of the mercury muſt be to increaſe the ſubtangent of the atmoſpherical logarithmic; in which caſe the logarithms of the denſities, as meaſured by inches of mercury, will expreſs meaſure that are greater than fathoms in the ſame proportion that the ſubtangent is increaſed; or, when the air is more expanded than the mercury, it will require a greater height of homogeneous atmoſphere to balance 30 inches of mercury, and a given fall of mercury will then correſpond to a thicker ſtratum of air.

In order, therefore, to perfect this method, we muſt learn by experiment how much mercury expands by an increaſe of temperature; we muſt alſo learn how much the air expands by the ſame, or any change of temperature; and how much its elaſticity is affected by it. Both theſe circumſtances muſt be conſidered in the caſe of air; for it might happen that the elaſticity of the air is not ſo much affected by heat as its bulk is.

It will, therefore, be proper to ſtate in this place the experiments which have been made for aſcertaining theſe two expanſions.

248 General Roy's experiments on the expanſion of mercury.

The moſt accurate, and the beſt adapted experiments for aſcertaing the expanſion of mercury, are thoſe of General Roy, publiſhed in the 67th volume of the Philoſophical Tranſactions. He expoſed 30 inches of mercury, actually ſupported by the atmoſphere in a barometer, in a nice apparatus, by which it could be made of one uniform temperature through its whole length; and he noted the expanſion of it in decimals of an inch. Theſe are contained in the following table; where the firſt column expreſſes the temperature by Fahrenheit's thermometer, the ſecond column expreſſes the bulk of the mercury, and the third column the expanſion of an inch of mercury for an increaſe of one degree in the adjoining temperatures.

Table A.

Temp.	Bulk of ☿.	Expan. for 1°
212°	30,5117	0,0000763
202	30,4888	0,0000787
192	30,4652	0,0000810
182	30,4409	0,0000833
172	30,4159	0,0000857
162	30,3902	0,0000880
152	30,3638	0,0000903
142	30,3367	0,0000923
132	30,3090	0,0000943
122	30,2807	0,0000963
112	30,2518	0,0000983
102	30,2223	0,0001003
92	30,1922	0,0001023
82	30,1615	0,0001043
72	30,1302	0,0001063
62	30,0984	0,0001077
52	30,0661	0,0001093
42	30,0333	0,0001110
32	30,0000	0,0001127
22	29,9662	0,0001143
12	29,9319	0,0001160
2	29,8971	0,0000177
0	29,8901	

249 This table gives riſe to ſome reflections. The ſcale of the thermometer is conſtructed on the ſuppoſition that the ſucceſſive degrees of heat are meaſured by equal increments of bulk in the mercury of the thermometer. How comes it, therefore, that this is not accompanied by equal increments of bulk in the mercury of the column, but that the correſponding expanſions of this column do continually diminiſh? General Roy attributes this to the gradual detachment of elaſtic matter from the mercury by heat, which preſſes on the top of the column, and therefore ſhortens it. He applied a boiling heat to the vacuum a-top, without producing any farther depreſſion; a proof that the barometer had been carefully filled. It had indeed been boiled through its whole length. He had attempted to meaſure the mercurial expanſion in the uſual way, by filling 30 inches of the tube with boiled mercury, and expoſing it to the heat with the open end uppermoſt. But here it is evident that the expanſion of the tube, and its ſolid contents, muſt be taken into the account. The expanſion of the tube was found ſo exceedingly irregular, and ſo incapable of being determined with preciſion for the tubes which were to be employed, that he was obliged to have recourſe to the method with the real barometer. In this no regard was neceſſary to any circumſtance but the perpendicular height. There was, beſides, a propriety in examining the mercury in the very condition in which it was uſed for meaſuring the preſſure of the atmoſphere; becauſe whatever complication there was in the reſults, it was the ſame in the barometer in actual uſe.

250 The moſt obvious manner of applying theſe experiments on the expanſion of mercury to our purpoſe, is to reduce the obſerved height of the mercury to what it would have been if it were of the temperature 32. Thus, ſuppoſe that the obſerved mercurial height is 29,2, and that the temperature of the mercury is 72° make 30,1302 : 30=29,2 : 29,0738. This will be the true meaſure of the denſity of the air of the ſtandard temperature. In order that we may obtain the exact temperature of the mercury, it is proper that the obſervation be made by means of a thermometer attached to the barometer-frame, ſo as to warm and cool along with it.

251 Or, this may be done without the help of a table, and with ſufficient accuracy, from the circumſtance that the expanſion of an inch of mercury for one degree diminiſhes very nearly $\frac{1}{500}$th part in each ſucceeding degree. If therefore we take from the expanſion at 32° its thouſandth part for each degree of any range above it, we obtain a mean rate of expanſion for that range. If the obſerved temperature of the mercury is below 32°, we muſt *add* this correction to obtain the mean expanſion. This rule will be made more exact if we ſuppoſe the expanſion at 32° to be =0,0001127. Then multiply the obſerved mercurial height by this expanſion, and we obtain the correction, to be ſubtracted or added according as the temperature of the mercury was above or below 32°. Thus to abide by the former example of 72°. This exceeds 32° by 40: therefore take 40 from 0,0001127, and we have 0,0001087 for the medium expanſion for that range. Multiply this by 40, and we have the whole expanſion of one inch of mercury, =0,004348. Multiply the inches of mercurial height, viz. 29,2, by this expanſion, and we have for the correction 0,12696; which being ſubtracted from the obſerved height leaves 29,07304, differing from the accurate quantity leſs than the thouſandth part of an inch. This rule is very eaſily kept in the memory, and ſuperſedes the uſe of a table.

252 This correction may be made with all neceſſary exactneſs by a rule ſtill more ſimple; namely, by multiplying the obſerved height of the mercury by the difference of its temperature from 32°, and cutting off four cyphers before the decimals of the mercurial height. This will ſeldom err $\frac{1}{100}$ of an inch. We even believe that it is the moſt exact method within the range of temperatures that can be expected to occur in meaſuring heights: for it appears, by comparing many experiments and obſervations, that General Roy's meaſure of the mercurial expanſion is too great, and that the expanſion of an inch of mercury between 20° and 70 of Fahrenheit's thermometer does not exceed 0,000102 *per* degree. Having thus corrected the obſerved mercurial heights by reducing them to what they would have been if the mercury had been of the ſtandard temperature, the logarithms of the corrected heights are taken, and their difference, multiplied by 10000, will give the difference of elevations in Engliſh fathoms.

253 There is another way of applying this correction, fully more expeditious and equally accurate. The difference of the logarithms of the mercurial heights is the meaſure of the ratio of thoſe heights. In like manner the difference of the logarithms of the obſerved and corrected heights at any ſtation is the meaſure of the ratio of thoſe heights. Therefore this laſt difference of the logarithms is the meaſure of the correction of this ratio. Now the obſerved height is to the corrected height nearly as 1 to 1,000102. The logarithm of this ratio, or the difference of the logarithms of 1 and 1,000102, is 0,0000444. This is the correction for each degree that the temperature of the mercury differs from 32. Therefore multiply 0,0000444 by the difference of the mercurial temperatures from 32, and the

products will be the corrections of the reſpective logarithms.

254 But there is ſtill an eaſier way of applying the logarithmic correction. If both the mercurial temperatures are the ſame, the differences of their logarithms will be the ſame, although each may be a good deal above or below the ſtandard temperature, if the expanſion be very nearly equable. The correction will be neceſſary only when the temperatures at the two ſtations are different, and will be proportional to this difference. Therefore, if the difference of the mercurial temperatures be multiplied by 0,0000444, the product will be the correction to be made on the difference of the logarithms of the mercurial heights.

But farther, ſince the differences of the logarithms of the mercurial heights are alſo the differences of elevation in Engliſh fathoms, it follows that the correction is alſo a difference of elevation in Engliſh fathoms, or that the correction for one degree of difference of mercurial temperature is $\frac{444}{1000}$ of a fathom, or 32 inches, or 2 feet 8 inches.

This correction of 2.8 for every degree of difference of temperature muſt be ſubtracted from the elevation found by the general rate, when the mercury at the upper ſtation is colder than that at the lower. For when this is the caſe, the mercurial column at the upper ſtation will appear too ſhort, the preſſure of the atmoſphere too ſmall, and therefore the elevation in the atmoſphere will appear greater than it really is.

255 Therefore the rule for this correction will be to multiply 0,0000444 by the degrees of difference between the mercurial temperatures at the two ſtations, and to add or ſubtract the product from the elevation found by the general rule, according as the mercury at the upper ſtation is hotter or colder than that at the lower.

256 If the experiments of General Roy on the expanſion of the mercury in a real barometer be thought moſt deſerving of attention, and the expanſion be conſidered as variable, the logarithmic difference correſponding to this expanſion for the *mean* temperature of the two barometers may be taken. Theſe logarithmic differences are contained in the following table, which is carried as far as 112°, beyond which it is not probable that any obſervations will be made. The number for each temperature is the difference between the logarithms of 30 inches, of the temperature 32, and of 30 inches expanded by that temperature.

TABLE B

Temp.	Log. diff.	Dec. of Fath.	Ft. In.
112°			
	0.0000427	,427	2.7
102			
	0.0000436	,436	2.7
92			
	0.0000444	,444	2.8
82			
	0.0000453	,453	2.9
72			
	0.0000460	,460	2.9
62			
	0.0000468	,468	2.10
52			
	0.0000475	,475	2.10
42			
	0 0000482	,482	2.11
32			
	0.0000489	,489	2.11
22			
	0.0000497	,497	3.0
12			
	0.0000504	,504	3.0
0			

257 The temperature of the air muſt alſo be attended to.

It is alſo neceſſary to attend to the temperature of the air; and the change that is produced by heat in its denſity is of much greater conſequence than that of the mercury. The relative gravity of the two, on which the ſubtangent of the logarithmic curve depends, and conſequently the unit of our ſcale of elevations, is much more effected by the heat of the air than by the heat of the mercury.

This adjuſtment is of incomparably greater difficulty than the former, and we can hardly hope to make it perfect. We ſhall narrate the chief experiments which have been made on the expanſion of air, and deduce from them ſuch rules as appear to be neceſſary conſequences of them, and then notice the circumſtances which leave the matter ſtill imperfect.

258 Compariſon of a mercurial and air thermometer.

General Roy compared a mercurial and an air thermometer, each of which was graduated arithmetically, that is, the units of the ſcales were equal bulks of mercury, and equal bulks (perhaps different from the former) of air. He found their progreſs as in the following table.

TABLE C.

Merc.	Diff.	Air.	Diff.
212		212,0	
	20		17,6
192		194,4	
	20		18,2
172		176,2	
	20		18,8
152		157,4	
	20		19,4
132		138,0	
	20		20,0
112		118,0	
	20		20,8
92		97,2	
	20		21,6
72		75,6	
	20		22,6
52		53,0	
	20		21,6
32		31,4	
	20		20,0
12		11,4	

259 It has been eſtabliſhed by many experiments that equal increments of heat produce equal increments in the bulk of mercury. The differences of temperature are therefore expreſſed by the ſecond column, and may be conſidered as equal; and the numbers of the third column muſt be allowed to expreſs the ſame temperatures with thoſe of the firſt. They *directly* expreſs the *bulks* of the air, and the numbers of the fourth column expreſs the differences of theſe bulks. Theſe are evidently unequal, and ſhow that common air expands moſt of all when of the temperature 62 nearly.

260 To determine an actual increaſe of bulk from a known increaſe of heat.

The next point was to determine what was the *actual* increaſe of bulk by ſome known increaſe of heat. For this purpoſe he took a tube, having a narrow bore, and a ball at one end. He meaſured with great care the capacity of both the ball and the tube, and divided the tube into equal ſpaces which bore a determined proportion to the capacity of the ball. This apparatus was ſet in a long cylinder filled with frigorific mixtures or with water, which could be uniformly heated up to the boiling temperature, and was accompanied by a nice thermometer. The expanſion of the air was meaſured by means of a column of mercury which roſe or ſunk in the tube. The tube being of a ſmall bore, the mercury did not drop out of it; and the bore being choſen as equable as poſſible, this column remained of an uniform length, whatever part of the tube it chanced to occupy. By this contrivance he was able to examine the expanſibility of air of various denſities. When the column of mercury contained only a ſingle drop or two, the air was nearly of the denſity of the external air. If he wiſhed to examine the expanſion of air twice or thrice as denſe, he uſed a column of 30 or 60 inches long: and to examine the expanſion of air that is rarer than the

Barometer.

the external air, he placed the tube with the ball uppermoſt, the open end coming through a hole in the bottom of the veſſel containing the mixtures or water. By this poſition the column of mercury was hanging in the tube, ſupported by the preſſure of the atmoſphere; and the elaſticity of the included air was meaſured by the difference between the ſuſpended column and the common barometer.

261 The following table contains the expanſion of 1000 parts of air, nearly of the common denſity, by heating it from 0 to 212. The firſt column contains the height of the barometer; the ſecond contains this height augmented by the ſmall column of mercury in the tube of the manometer, and therefore expreſſes the denſity of the air examined; the third contains the total expanſion of 1000 parts; and the fourth contains the expanſion for 1°, ſuppoſing it uniform throughout.

TABLE D.

Barom.	Denſity of Air examined.	Expanſion of 1000 pts by 212°.	Expanſion by 1°.
29,95	31,52	483,89	2,2825
30,07	30,77	482,10	2,2741
29,48	29,90	480,74	2,2676
29,90	30,73	485,86	2,2918
29,96	30,92	489,45	2,3087
29,90	30,55	476,04	2,2455
29,95	30,60	487,55	2,2998
30,07	30,60	482,80	2,2774
29,48	30,00	489,47	2,3087
Mean	30,62	484,21	2,2840

Hence it appears, that the mean expanſion of 1000 parts of air of the denſity 30,62 by one degree of Fahrenheit's thermometer is 2,284, or that 1000 becomes 1002,284.

262 If this expanſion be ſuppoſed to follow the ſame rate that was obſerved in the compariſon of the mercurial and air thermometer, we ſhall find that the expanſion of a thouſand parts of air for one degree of heat at the different intermediate temperatures will be as in the following table.

TABLE E.

Temp.	Total Expanſion.	Expanſion for 1°.
212	484,210	2,0099
192	444,011	2,0080
172	402,452	2,1475
152	359,503	2,2155
132	315,193	2,2840
112	269,513	2,3754
92	222,006	2,4211
82	197,795	2,5124
72	172,671	2,5581
62	147,090	2,6037
52	121,053	2,5124
42	95,929	2,4211
32	71,718	2,3297
22	48 421	2,2383
12	26,038	2,1698
0		

Taking heights.

If we would have a mean expanſion for any particular range, as between 12° and 92°, which is the moſt likely to comprehend all the geodætical obſervations, we need only take the difference of the bulks 26,038 and 222,006.=195,968, and divide this by the interval of temperature 80°, and we obtain 2,4496, or 2,45 for the mean expanſion for 1°.

263 It would perhaps be better to adapt the table to a maſs of 1000 parts of air of the ſtandard temperature 32°; for in its preſent form it ſhows the expanſibility of air originally of the temperature 0. This will be done with ſufficient accuracy by ſaying (for 212°) 107,718 : 1484,210=1000, : 13849, and ſo of the reſt. Thus we ſhall conſtruct the following table of the expanſion of 10,000 parts of air.

TABLE F.

Temp.	Bulk.	Differ.	Expanſ. for 1°.
212	13489	375	18,7
192	13474	387	19,3
172	13087	392	19,6
152	12685	413	20,6
132	12272	426	21,3
112	11846	443	22,1
92	11403	226	22,6
82	11177	235	23,5
72	10942	238	23,8
62	10704	243	24,3
52	10461	235	23,5
42	10226	226	22,6
32	10000	217	21,7
22	9783	209	20,9
12	9574	243	20,2
0	9331		

This will give for the mean expanſion of 1000 parts of air between 12° and 92=2,29.

264 General Roy's experiments on air above the common denſity.

Although it cannot happen that in meaſuring the differences of elevation near the earth's ſurface, we ſhall have occaſion to employ air greatly exceeding the common denſity, we may inſert the experiments made by General Roy on ſuch airs. They are expreſſed in the following table; where column firſt contains the denſities meaſured by the inches of mercury that they will ſupport when of the temperature 32°; column ſecond is the expanſion of 1000 parts of ſuch air by being heated from 0 to 212; and column third is the mean expanſion for 1°.

TABLE G.

	Denſity.	Expanſion for 212.	Expanſ. for 1°.
	101,7	451,54	2,130
	92,3	423,23	1,996
	80,5	412,09	1,944
	54,5	439,87	2,075
	49,7	443,24	2,091
Mean	75,7	434	2,047

265 And on air below that denſity.

We have much more frequent occaſion to operate in air that is rarer than the ordinary ſtate of the ſuperficial atmoſphere. General Roy accordingly made many experiments on ſuch airs. He found in general, that their expanſibility by heat was analogous to that of air in its ordinary denſity, being greateſt about the temperature 60°. He found, too, that its expanſibility by heat diminiſhed with its denſity, but he could not determine the law of gradation. When reduced to about $\frac{1}{3}$ of the denſity of common air, its expanſion was as follows.

TABLE H.

Temp.	Bulk.	Difference.	Expanſ. for 1°.
212	1141,504		
192	1134,429	7,075	0,354
172	1122,165	12,264	0,613
152	1108,015	14,150	0,708
132	1093,864	14,151	0,708
112	1079,636	14,228	0,711
92	1064,699	14,937	0,747
72	1043,788	20,911	1,045
52	1017,845	25,943	1,297
32	1000,000	17,845	0,822
	Mean expanſion		0,786

266 Air of ordinary denſity expands moſt, &c.

From this very extenſive and judicious range of experiments, it is evident that the expanſibility of air by heat is greateſt when the air is about its ordinary denſity, and that in ſmall denſities it is greatly diminiſhed. It appears alſo, that the law of compreſſion is altered; for in this ſpecimen of the rare air half of the whole expanſion happens about the temperature 99°, but in air of ordinary denſity at 105°. This being the caſe, we ſee that the experiments of Mr Amontons, narrated in, the Memoirs of the Academy at Paris 1702, &c. are not inconſiſtent with thoſe more conſpicuous experiments of General Roy. Amontons found, that whatever was the denſity of the air, at leaſt in caſes much denſer than ordinary air, the change of 180° of temperature increaſed its elaſticity in the ſame proportion: for he found, that the column of mercury which it ſupported when of the temperature 50, was increaſed $\frac{1}{3}$ at the temperature 212. Hence he haſtily concluded, that its expanſibility was increaſed in the ſame proportion; but this by no means follows, unleſs we are certain that in every temperature the elaſticity is proportional to the denſity. This is a point which ſtill remains undecided; and it merits attention, becauſe if true it eſtabliſhes a remarkable law concerning the action of heat, which would ſeem to go to prove that the elaſticity of fluids is the property of the matter of fire, which it ſuperinduces on every body with which it combines in the form of vapour.

267 The height which produces a given fall in the barometer, increaſes with the air's expanſion.

After this account of the expanſion of air, we ſee that the height through which we muſt riſe in order to produce a given fall of the mercury in the barometer, or the thickneſs of the ſtratum of air equiponderant with a tenth of an inch of mercury, muſt increaſe with the expanſion of air; and that if $\frac{2,29}{1000}$ be the expanſion for one degree, we muſt multiply the exceſs of the temperature of the air above 32° by 0,00229, and multiply the product by 87, in order to obtain the thickneſs of the ſtratum where the barometer ſtands at 30 inches: or whatever be the elevation indicated by the difference of the barometrical heights, upon the ſuppoſition that the air is of the temperature 32°, we muſt multiply this by 0,00229 for every degree that the air is warmer or colder than 32. The product muſt be added to the elevation in the firſt caſe, and ſubtracted in the latter.

268

Sir George Shuckbourgh deduces 0,0024 from his experiments as the mean expanſion of air in the ordinary caſes: and this is probably nearer the truth; becauſe General Roy's experiments were made on air which was freer from damp than the ordinary air in the fields; and it appears from his experiments, that a very minute quantity of damp increaſes its expanſibility by heat in a prodigious degree.

269 Difficulties in this mode of meaſuring heights.

The great difficulty is how to apply this correction; or rather, how to determine the temperature of the air in thoſe extenſive and deep ſtrata in which the elevations are meaſured. It ſeldom or never happens that the ſtratum is of the ſame temperature throughout. It is commonly much colder aloft; it is alſo of different conſtitutions. Below it is warm, loaded with vapour, and very expanſible; above it is cold, much drier, and leſs expanſible, both by its dryneſs and its rarity. The currents of wind are often diſpoſed in ſtrata, which long retain their places; and as they come from different regions, are of different temperatures and different conſtitutions. We cannot therefore determine the expanſion of the whole ſtratum with preciſion, and muſt content ourſelves with an approximation: and the beſt approximation that we can make is, by ſuppoſing the whole ſtratum of a mean temperature between thoſe of its upper and lower extremity, and employ the expanſion correſponding to that mean temperature.

This, however, is founded on a gratuitous ſuppoſition, that the whole intermediate ſtratum expands alike, and that the expanſion is equable in the different intermediate temperatures; but neither of theſe are warranted by experiment. Rare air expands leſs than what is denſer; and therefore the general expanſion of the whole ſtratum renders its denſity more uniform. Dr Horſley has pointed out ſome curious conſequences of this in Phil. Tranſ. Vol. LXIV. There is a particular elevation at which the general expanſion, inſtead of diminiſhing the denſity of the air, increaſes it by the ſuperior expanſion of what is below; and we know that the expanſion is not equable in the intermediate temperatures: but we cannot find out a rule which will give us a more accurate correction than by taking the expanſion for the mean temperature.

When we have done this, we have carried the method of meaſuring heights by the barometer as far as it can go; and this ſource of remaining error makes it needleſs to attend to ſome other very minute equations which theory points out. Such is the diminution of the weight of the mercury by the change of diſtance from the centre of the earth. This accompanies the diminution of the weight of the air, but neither ſo as to compenſate it, nor to go along with it *pari paſſu*.

After all, there are found caſes where there is a regular deviation from thoſe rules, of which we cannot give any very ſatisfactory account. Thus it is found, that in the province of Quito in Peru, which is at a great elevation above the ſurface of the ocean, the heights obtained by theſe rules fall conſiderably ſhort of the real heights; and at Spitſbergen they conſiderably exceed them. It appears that the air in the circumpolar regions is denſer than the air of the temperate climates when of the ſame heat and under the ſame preſſure; and the contrary ſeems to be the caſe with the air in the torrid zone. It would ſeem that the ſpecific gravity of air to mercury is at Spitſbergen about 1 to 10224, and in Peru about 1 to 13100. This difference is with great probability aſcribed to the greater dryneſs of the circumpolar air.

This ſource of error will always remain; and it is combined with another, which ſhould be attended to by all who practiſe this method of meaſuring heights, namely, a difference in the ſpecific gravity of the quickſilver. It is thought ſufficiently pure for a barometer when it is cleared of all calcinable matter, ſo as not to drag or ſully the tube. In this ſtate it may contain a conſiderable portion of other metals, particularly of ſilver, biſmuth, and tin, which will diminiſh its ſpecific gravity. It has been obtained by revivification from cinnabar of the ſpecific gravity 14,229, and it is thought very fine if 13,65. Sir George Shuckbourgh found the quickſilver which agreed preciſely with the atmoſpherical obſervations on which the rules are founded to have the ſpecific gravity 13,61. It is ſeldom obtained ſo heavy. It is evident that theſe variations will change the whole reſults; and that it is abſolutely neceſſary, in order to obtain preciſion, that we know the denſity of the mercury employed. The ſubtangent of the atmoſpherical logarithmic, or the height of the homogeneous atmoſphere, will increaſe in the ſame proportion with the denſity of the mercury; and the elevation correſponding to $\frac{1}{10}$ of an inch of barometric height will change in the ſame proportion.

We muſt be contented with the remaining imperfections: and we can readily ſee, that, for any purpoſe that can be anſwered by ſuch meaſurements of great heights, the method is ſufficiently exact; but it is quite inadequate to the purpoſe of taking accurate levels, for directing the conſtruction of canals, aqueducts, and other works of this kind, where extreme preciſion is abſolutely neceſſary.

We ſhall now deduce from all that has been ſaid on this ſubject ſets of eaſy rules for the practice of this mode of meaſurement, illuſtrating them by an example.

1. *M. de Luc's Method.*

270 Mode of meaſuring heights by the barometer according to De Luc,

I. Subtract the logarithm of the barometrical height at the upper ſtation from the logarithm of that at the lower, and count the index and four firſt decimal figures of the remainder as fathoms, the reſt as a decimal fraction. Call this the *elevation*.

II. Note the different temperatures of the mercury at the two ſtations, and the mean temperature. Multiply the logarithmic expanſion correſponding to this mean temperature (in Table B, p. 126.) by the difference of the two temperatures, and ſubtract the product from the elevation if the barometer has been coldeſt at the upper ſtation, otherwiſe add it. Call the difference or the ſum the *approximated elevation.*

III. Note the difference of the temperatures of the air at the two ſtations by a detached thermometer, and alſo the mean temperature and its difference from 32°. Multiply this difference by the expanſion of air for the mean temperature, and multiply the approximate elevation by 1 ± this product, according as the air is above or below 32°. The product is the correct elevation in fathoms and decimals.

Example.

Suppoſe that the mercury in the barometer at the lower ſtation was at 29,4 inches, that its temperature was 50°, and the temperature of the air was 45; and let the height of the mercury at the upper ſtation be 25,19 inches, its temperature 46, and the temperature of the air 39. Thus we have.

☿al Hts.	Temp. ☿.	Mean.	Temp. Air.	Mean.
29,4	50	48	45	42
25,19	46^{4}		39	

I. Log. of 29,4 -		1.4683473
Log. of 25.19 - -		1.4012282
Elevation in fathoms - -		671,191
II. Expanſ. for 48°	,473	
Multiply by -	4	
-		1,892
Approximated elevation -		669,299
III. Expanſ. of air at 42	0,00238	
×42—32,=10°	10	
	0,0238	
Multiply - -		669,2990
By - - - -		1,0238
Product = the correct elevation		685,228

2. *Sir George Shuckbourgh's Method.*

271 And according to Shuckbourgh.

I. Reduce the barometric heights to what they would be it they were of the temperature 32°.

II. The difference of the logarithms of the reduced barometrical heights will give the approximate elevation.

III. Correct the approximated elevation as before.

Same Example.

I. Mean expanſ. for 1° from Tab. A, p. 125. is 0,000111.

18°×0,000111×29,4= - -	0,059
Subtract this from . -	29,4
Reduced barometric height -	29,341

Expanſ. from Tab. A, p. 125. is 0,000111.

14°×0,000111×25,19 - -	0,039
Subtract from - -	25,190
Reduced barometric height -	25,151
II. Log. 29,341 - -	1.4674749
Log. 25.151 - -	1.4005553
Approximated elevation -	669,196
III. This multiplied by 1,0238 gives	685,125

272 Remarks on this method.

Remark 1. If 0,000101 be ſuppoſed the mean expanſion of mercury for 1°, as Sir George Shuckbourgh determines it, the reduction of the barometric heights will be had ſufficiently exact by multiplying the obſerved heights of the mercury by the difference of its temperatures from 32, and cutting off four more decimal places; thus $29{,}4\frac{\times 18}{10000}$ gives for the reduced height 29,347, and $25{,}19\times\frac{14}{10000}$ gives 25,155, and the difference of their logarithms gives 669,4 fathoms for the approximated elevation, which differs from the one given above by no more than 15 inches.

273 *Remark* 2. If 0,0024 be taken for the expanſion of air for one degree, the correction for this expanſion will be had by multiplying the approximated elevation by 12, and this product by the ſum of the differences of the temperatures from 32°, counting that difference as negative when the temperature is below 32, and cutting off four places; thus $669{,}196\times 12\times\overline{13+07}\times\frac{1}{10000}=$ 16,061, which added to 669,196 gives 685,257, differing from the former only 9 inches.

274 An eaſy rule without the help of tables.

From the ſame premiſes we may derive a rule, which is abundantly exact for all geodætical purpoſes, and which requires no tables of any kind, and is eaſily remembered.

1. The height through which we muſt riſe in order to produce any fall of the mercury in the barometer is inverſely proportional to the denſity of the air, that is, to the height of the mercury in the barometer.

2. When the barometer ſtands at 30 inches, and the air and quickſilver are of the temperature 32, we muſt riſe through 87 feet, in order to produce a depreſſion of $\frac{1}{10}$ of an inch.

3. But if the air be of a different temperature, this 87 feet muſt be increaſed or diminiſhed by 0,21 of a foot for every degree of difference of the temperature from 32°.

4. Every degree of difference of the temperatures of the mercury at the two ſtations makes a change of 2,833 feet, or 2 feet 10 inches in the elevation.

Hence the following rule.

275 1. Take the difference of the barometric heights in tenths of an inch. Call this *d*.

2. Multiply the difference *a* between 32, and the mean temperature of the air by 21, and take the ſum or difference, of this product and 87 feet. This is the height through which we muſt riſe to cauſe the barometer to fall from 30 inches to 29,9. Call this height *h*.

Let *m* be the mean between the two barometric heights. Then $\frac{30dh}{m}$ is the approximated elevation very nearly.

Multiply the difference δ of the mercurial temperatures by 2,83 feet, and add this product to the approximated elevation if the upper barometer has been the warmeſt, otherwiſe ſubtract it. The reſult, that is, the ſum or difference, will be the corrected elevation.

Same Example.

$d=294\quad 251{,}9=42{,}1$

$h=87+10\times 0{,}21,=89{,}1$

$m=\frac{29{,}4+25.19}{2}=27{,}29$

Approx. elevation $=\frac{30\times 42{,}1\times 89{,}1}{27{,}29},=4123{,}24$ feet.

Corr. for temp. of mercury, $=4\times 2{,}83$ 1132

Corrected elevation in feet - 4111,92

Ditto in fathoms - - 685,32

Differing from the former only 15 inches.

276 This rule may be expreſſed by the following ſimple and eaſily remembered formula, where *a* is the difference between 32° and the mean temperature of the air, *d* is the difference of barometric heights in tenths of an inch, *m* is the mean barometric height, δ the difference between the mercurial temperatures, and E is the correct elevation. $E=\frac{30(87\pm 0{,}21a)d}{m}\pm\delta\ 2{,}83$.

277 Heights of the moſt remarkable mountains.

We ſhall now conclude this ſubject by an account of ſome of the moſt remarkable mountains, &c. on the earth, above the ſurface of the ocean, in feet.

Mount Puy de Domme in Auvergne, the firſt mountain meaſured by the barometer		5088
Mount Blanc	Alps	15662
Monte Roſa		15084
Aiguille d'Argenture		13402
Monaſtery of St Bernard		7944
Mount Cenis		9212
Pic de los Reyes	Pyrenees	7620
Pic du Medi		9300
Pic d'Oſſano		11700
Canegou		8544
Lake of Geneva		1232
Mount Ætna		10954
Mount Veſuvius		3938
Mount Hekla in Iceland		4887
Snowdown		3555
Ben Moir		3723
Ben Laurs		3858
Ben Gloe		3472
Shihallion		3461
Ben Lomond		3180
Tinto		2342
Table Hill, Cape of Good Hope		3454
Gondar city in Abyſſinia		8440
Source of the Nile		8082
Pic of Teneriffe		14026
Chimboraçon		19595
Cayambourow		19391
Antiſana		19290
Pichinha (ſee PERU, n° 56.)		15670
City of Quito (ſee ditto)		9977
Caſpian Sea below the ocean		306

This laſt is ſo ſingular, that it is neceſſary to give the authority on which this determination is founded. It is deduced from nine years obſervations with the barometer at Aſtrachan by Mr Lecre, compared with a ſeries of obſervations made with the ſame barometer at St Peterſburgh.

278 Improved barometers, with a deſcription of Hooke's.

This employment of the barometer has cauſed it to become a very intereſting inſtrument to the philoſopher and to the traveller; and many attempts have been made of late to improve it, and render it more portable. The improvements have either been directed to the enlargement of its range, or to the more accurate meaſurement of its preſent ſcale. Of the firſt kind are Hooke's wheel barometer, the diagonal barometer, and the horizontal, barometer, deſcribed in a former volume of this work. See BAROMETER. In that place are alſo deſcribed two very ingenious contrivances of Mr Rownings, which are evidently not portable. Of all the barometers with an enlarged ſcale the beſt is that invented by Dr Hooke in 1668, and deſcribed in the Phil. Tranſ. N° 185. The invention was alſo claimed by Huyghens and by De la Hire; but Hooke's was publiſhed long before.

Plate CCCCIV. It conſiſts of a compound tube ABCDEFG (fig. 56.), of which the parts AB and DE are equally wide, and EFG as much narrower as we would amplify the ſcale. The parts AB and EG muſt alſo be as perfectly cylindrical as poſſible. The part HBCDI is filled with mercury, having a vacuum above in AB. IF is filled with a light fluid, and FG with another light fluid which will not mix with that in IF. The ciſtern G is of the ſame diameter as AB. It is eaſy to ſee that the range of the ſeparating ſurface at F muſt be as much greater than that of the ſurface I as the area of I is greater than that of F. And this ratio is in our choice. This barometer is free from all the bad qualities of thoſe formerly deſcribed, being moſt delicately moveable; and is by far the fitteſt for a chamber, for amuſement, by obſervations on the changes of the atmoſpheric preſſure. The ſlighteſt breeze cauſes it to riſe and fall, and it is continually in motion.

279 Inferior to the common one for the meaſurement of heights.

But this, and all other contrivances of the kind, are inferior to the common barometer for meaſurement of heights, on account of their bulk and cumberſomeneſs: nay, they are inferior for all philoſophical purpoſes in point of accuracy; and this for a reaſon that admits of no reply. Their ſcale muſt be determined in all its parts by the common barometer; and therefore, notwithſtanding their great range, they are ſuſceptible of no greater accuracy than that with which the ſcale of a common barometer can be obſerved and meaſured. This will be evident to any perſon who will take the trouble of conſidering how the points of their ſcale muſt be aſcertained. The moſt accurate method for graduating ſuch a barometer as we have now deſcribed would be to make a mixture of vitriolic acid and water, which ſhould have $\frac{1}{10}$ of the denſity of mercury. Then, let a long tube ſtand vertical in this fluid, and connect its upper end with the open end of the barometer by a pipe which has a branch to which we can apply the mouth. Then if we ſuck through this pipe, the fluid will riſe both in the barometer and in the other tube; and 10 inches riſe in this tube will correſpond to one inch deſcent in the common barometer. In this manner may every point of the ſcale be adjuſted in due proportion to the reſt. But it ſtill remains to determine what particular point of the ſcale correſponds to ſome determined inch of the common barometer. This can only be done by an actual compariſon; and this being done, the whole becomes equally accurate. Except therefore for the mere purpoſe of chamber amuſement, in which caſe the barometer laſt deſcribeſt has a decided preference, the common barometer is to be preferred; and our attention ſhould be entirely directed to its improvement and portability.

280 How the common one might be improved.

For this purpoſe it ſhould be furniſhed with two microſcopes or magnifying glaſſes, one of them ſtationed at the beginning of the ſcale; which ſhould either be moveable, ſo that it may always be brought to the ſurface of the mercury in the ciſtern, or the ciſtern ſhould be ſo contrived that its ſurface may always be brought to the beginning of the ſcale. The glaſs will enable us to ſee the coincidence with accuracy. The other microſcope muſt be movable, ſo as to be ſet oppoſite to the ſurface of the mercury in the tube; and the ſcale ſhould be furniſhed with a vernier which divides an inch into 1000 parts, and be made of materials of which we know the expanſion with great preciſion.

281 For an account of many ingenious contrivances to make the inſtrument accurate, portable, and commodious, conſult Magellan, *Diſſer. de diverſes Inſtr. de Phyſ.*; *Phil. Tranſ.* lxvii. lxviii.; *Journ. de Phyſ.* xix. 108. 346. xvi. 392. xviii. 391. xxi. 436. xxii. 390.; Sulzer, *Act. Helvet.* iii. 259.; De Luc, *Recherches ſur les Modifications de l'Atmoſphere*, i. 401. ii. 459, 490. De Luc's ſeems the moſt ſimple and perfect of them all. Cardinal de Luynes (*Mem. Par.* 1768); Prinſ. De Luc, *Recherches*, § 63.; Van Swinden's *Poſitiones Phyſicæ*; *Com. Acad. Petrop.* i.; *Com. Acad. Petrop. Nov.* ii. 200. viii.

THUS we have given an elementary account of the diſtinguiſhing properties of air as a heavy and compreſſible fluid, and of the general phenomena which are immediate conſequences of theſe properties. This we have done in a ſet of propoſitions analogous to thoſe which form the doctrines of hydroſtatics. It remains to conſider it in another point of view, namely, as moveable and inert. The phenomena conſequent on theſe properties are exhibited in the velocities which air acquires by preſſure, in the reſiſtence which bodies meet with to their motion through the air, and in the impreſſion which air in motion gives to bodies expoſed to its action.

We ſhall firſt conſider the motions of which air is ſuſceptible when the equilibrium of preſſure (whether ariſing from its weight or its elaſticity) is removed; and, in the next place, we ſhall conſider its action on ſolid bodies expoſed to its current, and the reſiſtance which it makes to their motion through it.

282 Doctrine of air in acceſſible ſituations as acted on by equal and parallel gravity

In this conſideration we ſhall avoid the extreme of generality, which renders the diſcuſſion too abſtract and difficult, and adapt our inveſtigation to the circumſtances in which compreſſible fluids (of which air is taken for the repreſentative) are moſt commonly found. We ſhall conſider air therefore as it is commonly found in acceſſible ſituations, as acted on by equal and parallel gravity; and we ſhall conſider it in the ſame order in which water is treated in a ſyſtem of hydraulics.

283 Analogous to the doctrine of water in hydraulics.

In that ſcience the leading problem is to determine with what velocity the water will move through a given orifice when impelled by ſome known preſſure; and it has been found, that the beſt form in which this moſt difficult and intricate propoſition can be put, is to determine the velocity of water flowing through this orifice when impelled by its weight alone. Having determined this, we can reduce to this caſe every queſtion which can be propoſed; for, in place of the preſſure of any piſton or other mover, we can always ſubſtitute a perpendicular column of water or air whoſe weight ſhall be equal to the given preſſure.

284 The velocity with which air ruſhes into a void by its own weight,

The firſt problem, therefore, is to determine with what velocity air will ruſh into a void when impelled by its weight alone. This is evidently analogous to the hydraulic problem of water flowing out of a veſſel.

And here we muſt be contented with referring our readers to the ſolutions which have been given of that problem, and the demonſtration that it flows with the velocity which a heavy body would acquire by falling from a height equal to the depth of the hole under the ſurface of the water in the veſſel. In whatever way we attempt to demonſtrate that propoſition, every ſtep, nay, every word, of the demonſtration applies equally to the air, or to any fluid whatever. Or, if our readers ſhould wiſh to ſee the connection or analogy of the caſes, we only deſire them to recollect an undoubted maxim in the ſcience of motion, that *when the moving force and the matter to be moved vary in the ſame proportion, the velocity will be the ſame.* If therefore there be ſimilar veſſels of air, water, oil, or any other fluid, all of the height of a homogeneous atmoſphere, they will all run through equal and ſimilar holes with the ſame velocity; for in whatever proportion the quantity of matter moving through the hole be varied by a variation of denſity, the preſſure which forces it out, by acting in circumſtances perfectly ſimilar, varies in the ſame proportion by the ſame variation of denſity.

We muſt therefore aſſume it as the leading propoſition, that *air ruſhes from the atmoſphere into a void with the velocity which a heavy body would acquire by falling from the top of a homogeneous atmoſphere.*

It is known that air is about 840 times lighter than water, and that the preſſure of the atmoſphere ſupports water at the height of 33 feet nearly. The height therefore of a homogeneous atmoſphere is nearly 33×840, or 27720 feet. Moreover, to know the velocity acquired by any fall, recollect that a heavy body by falling one foot acquires the velocity of 8 feet per ſecond; and that the velocities acquired by falling thro' different heights are as the ſquare roots of the heights. Therefore, to find the velocity correſponding to any height, expreſſed in feet per ſecond, multiply the ſquare root of the height by 8. We have therefore in the preſent inſtance $V = 8\sqrt{27220}, = 8 \times 166{,}493, = 1332$ feet per ſecond. This therefore is the velocity with which common air will ruſh into a void; and this may be taken as a ſtandard number in pneumatics, as 16 and 32 are ſtandard numbers in the general ſcience of mechanics, expreſſing the action of gravity at the ſurface of the earth.

It is eaſy to ſee that greater preciſion is not neceſſary in this matter. The height of a homogeneous atmoſphere is a variable thing, depending on the temperature of the air. If this reaſon ſeems any objection againſt the uſe of the number 1332, we may retain $8\sqrt{H}$ in place of it, where H expreſſes the height of a homogeneous atmoſphere of the given, temperature. A variation of the barometer makes no change in the velocity, nor in the height of the homogeneous atmoſphere, becauſe it is accompanied by a proportional variation in the denſity of the air. When it is increaſed $\frac{1}{10}$, for inſtance, the denſity is alſo increaſed $\frac{1}{10}$; and thus the expelling force and the matter to be moved are changed in the ſame proportion, and the velocity remains the ſame. N. B. We do not here conſider the velocity which the air acquires after its iſſuing into the void by its continual expanſion. This may be aſcertained by the 39th prop. of Newton's *Principia*, b. i. Nay, which appears very paradoxical, if a cylinder of air, communicating in this manner with a void, be compreſſed by a piſton loaded with a weight, which preſſes it down as the air flows out, and thus keeps it of the ſame denſity, the velocity of efflux will ſtill be the ſame however great the preſſure may chance to be: for the firſt and immediate effect of the load on the piſton is to reduce the air in the cylinder to ſuch a denſity that its elaſticity ſhall exactly balance the load; and becauſe the elaſticity of air is proportional to its denſity, the denſity of the air will be increaſed in the ſame proportion with the load, that is, with the expelling power (for we are neglecting at preſent the weight of the included air as too inconſiderable to have any ſenſible effect.) Therefore, ſince the matter to be moved is increaſed in the ſame proportion with the preſſure, the velocity will be the ſame as before.

285
And the velocity with which it ruſhes into a ſpace containing rarer air,

It is equally eaſy to determine the velocity with which the air of the atmoſphere will ruſh into a ſpace containing rarer air. Whatever may be the denſity of this air, its elaſticity, which follows the proportion of its denſity, will balance a proportional part of the preſſure of the atmoſphere; and it is the exceſs of this laſt only which is the moving force. The matter to be moved is the ſame as before. Let D be the natural denſity of the air and δ the denſity of the air contained in the veſſel into which it is ſuppoſed to run, and let P be the preſſure of the atmoſphere, and therefore equal to the force which impels it into a void; and let π be the force with which this rarer air would run into a void. We have $D : \delta = P : \pi$, and $\pi = \frac{P\delta}{D}$. Now the moving force in the preſent inſtance is $P - \pi$, or $P - \frac{P\delta}{D}$. Laſtly, let V be the velocity of air ruſhing into a void, and v the velocity with which it will ruſh into this rarefied air.

It is a theorem in the motion of fluids, that the preſſures are as the ſquares of the velocities of efflux. Therefore $P : P - \frac{P\delta}{D} = V^2 : v^2$. Hence we derive $v^2 = V^2 \times \overline{1 - \frac{\delta}{D}}$, and $v = V \times \sqrt{1 - \frac{\delta}{D}}$. We do not here conſider the reſiſtance which the air of the atmoſphere will meet with from the inertia of that in the veſſel which it muſt diſplace in its motion.

Here we ſee that there will always be a current into the veſſel while δ is leſs than D.

We alſo learn the gradual diminution of the velocity as the veſſel fills; for δ continually increaſes, and therefore $1 - \frac{\delta}{D}$ continually diminiſhes.

It remains to determine the time t expreſſed in ſeconds, in which the air of the atmoſphere will flow into this veſſel from its ſtate of vacuity till the air in the veſſel has acquired any propoſed denſity δ.

For this purpoſe let H, expreſſed in feet, be the height through which a heavy body muſt fall in order to acquire the velocity V, expreſſed alſo in feet per ſecond. This we ſhall expreſs more briefly in future, by calling it the height producing the velocity V. Let C repreſent the capacity of the veſſel, expreſſed in cubic feet,

Fig. 45.

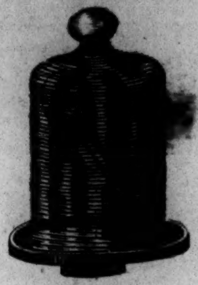

Fig. 44.

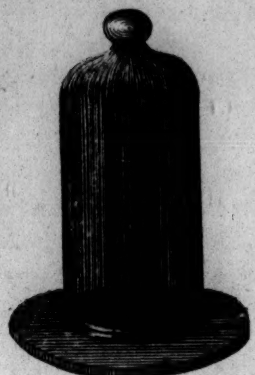

Fig. 47. No. 1.

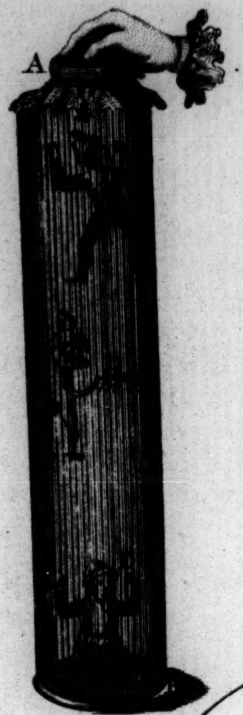

Fig. 55.

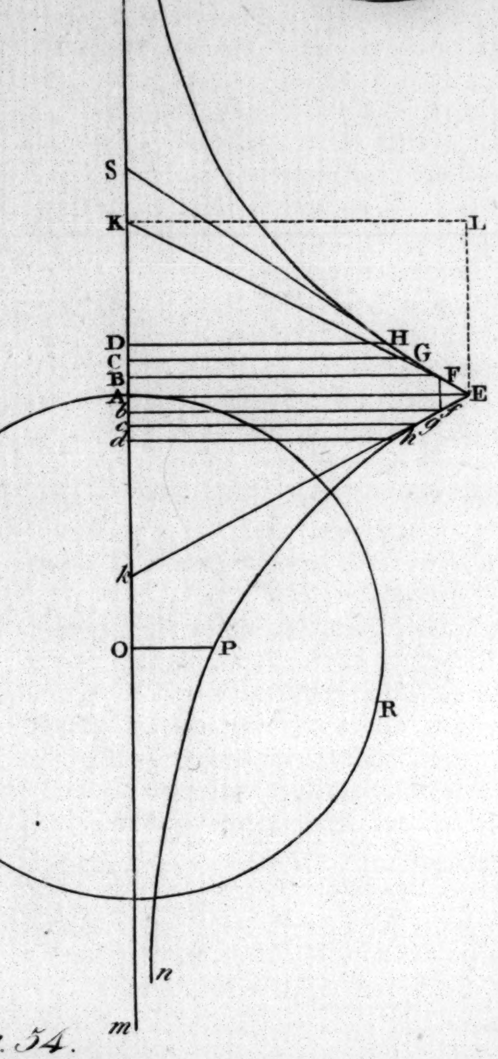
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Fig. 46.

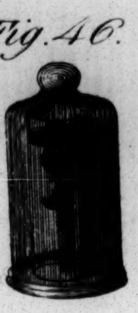

Fig. 49.

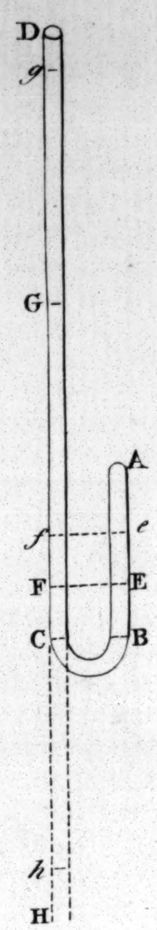
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Fig. 50.

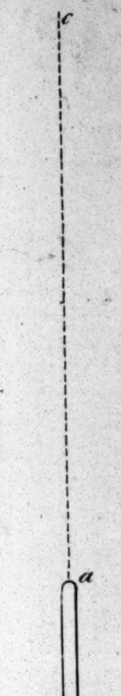


Fig. 51.

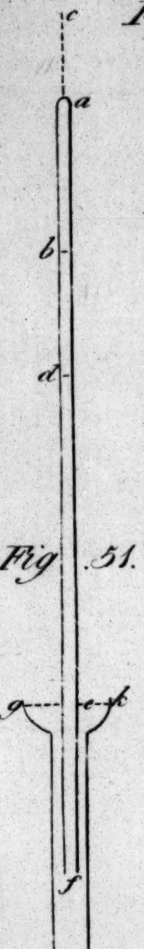


Fig. 47. No. 2.

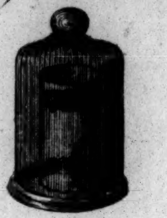


Fig. 52.

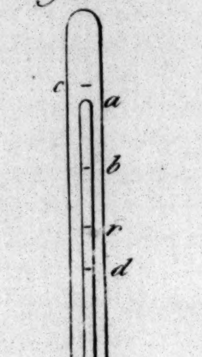


Fig. 48.

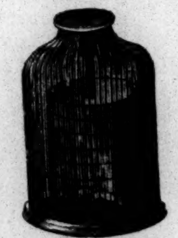


Fig. 54.

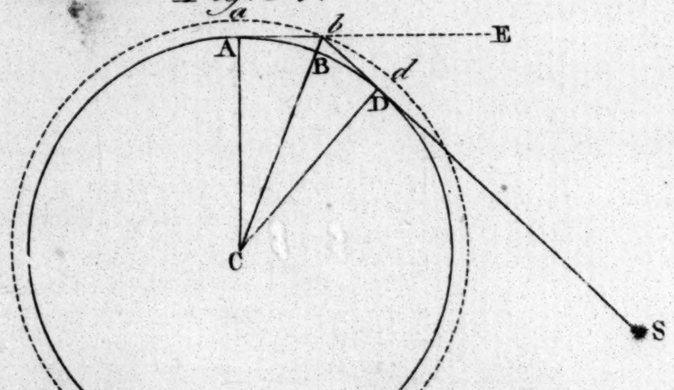


Fig. 56.

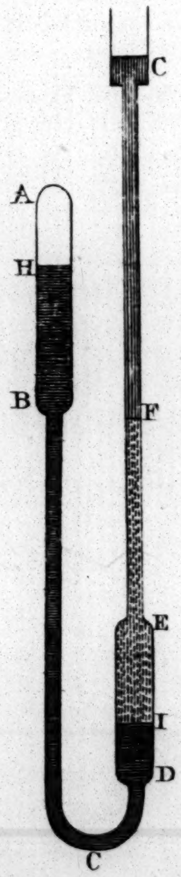
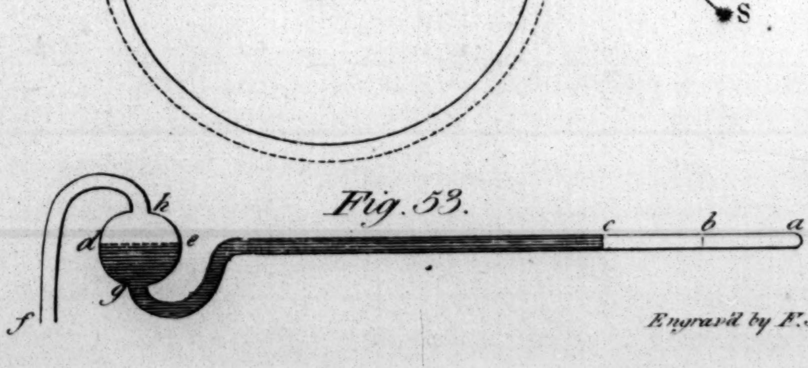


Fig. 53.



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feet, and O the area or ſection of the orifice, expreſſed in ſuperficial or ſquare feet; and let the natural denſity of the air be D.

Since the quantity of aerial matter contained in a veſſel depends on the capacity of the veſſel and the denſity of the air jointly, we may expreſs the air which would fill this veſſel by the ſymbol CD when the air is in its ordinary ſtate, and by Cδ when it has the denſity δ. In order to obtain the rate at which it fills, we muſt take the fluxion of this quantity Cδ. This is C$\dot{\delta}$; for C is a conſtant quantity, and δ is a variable or flowing quantity.

But we alſo obtain the rate of influx by our knowledge of the velocity, and the area of the orifice, and the denſity. The velocity is V, or $8\sqrt{H}$, at the firſt inſtant; and when the air in the veſſel has acquired the denſity δ, that is, at the end of the time t, the velocity is $8\sqrt{H}\sqrt{1-\frac{\delta}{D}}$, or $8\sqrt{H}\sqrt{\frac{D-\delta}{D}}$, or $8\sqrt{H}\frac{\sqrt{D-\delta}}{\sqrt{D}}$.

The rate of influx therefore (which may be conceived as meaſured by the little maſs of air which will enter during the time $\dot{t}$ with this velocity) will be $\frac{8\sqrt{HOD}\sqrt{D-\delta}\,\dot{t}}{\sqrt{D}}$, or $8\sqrt{HO}\sqrt{D}\sqrt{D-\delta}\,\dot{t}$, multiplying the velocity by the orifice and by the denſity.

Here then we have two values of the rate of influx. By ſtating them as equal we have a fluxionary equation, from which we may obtain the fluents, that is, the time t in ſeconds neceſſary for bringing the air in the veſſel to the denſity δ, or the denſity δ which will be produced at the end of any time t. We have the equation $8\sqrt{HO}\sqrt{D}\sqrt{D-\delta}\,\dot{t}=C\dot{\delta}$. Hence we derive $\dot{t}=\frac{C}{8\sqrt{HO}\sqrt{D}}\times\frac{\dot{\delta}}{\sqrt{D-\delta}}$. Of this the fluent is $t=\frac{C}{4\sqrt{HO}\sqrt{D}}\times\sqrt{D-\delta}+A$, in which A is a conditional conſtant quantity. The condition which determines it is, that t muſt be nothing when δ is nothing that is, when $\sqrt{D-\delta}=\sqrt{D}$; for this is evidently the caſe at the beginning of the motion. Hence it follows, that the conſtant quantity is $\sqrt{D}$, and the complete fluent, ſuited to the caſe, is

$$\frac{C}{4\sqrt{HO}\sqrt{D}}\times\overline{\sqrt{D}-\sqrt{D-\delta}}.$$

The motion ceaſes when the air in the veſſel has acquired the denſity of the external air; that is, when $\delta=D$, or when $t=\frac{C}{4\sqrt{HO}\sqrt{D}}\times\sqrt{D}, =\frac{C}{4\sqrt{HO}}$. Therefore the time of completely filling the veſſel is $\frac{C}{4\sqrt{HO}}$.

286 Illuſtrated by examples in numbers.

Let us illuſtrate this by an example in numbers.

Suppoſing then that air is 840 times lighter than water, and the height of the homogeneous atmoſphere 27720 feet, we have $4\sqrt{H}=666$. Let us further ſuppoſe the veſſel to contain 8 cubic feet, which is nearly a wine hogſhead, and that the hole by which the air of the ordinary denſity, which we ſhall make $=1$, enters is an inch ſquare, or $\frac{1}{144}$ of a ſquare foot. Then the time in ſeconds of completely filling it will be $\frac{8''}{\frac{1}{144}666}$, or $\frac{1152''}{666}$, or 1,7297″. If the hole is only $\frac{1}{100}$ of a ſquare inch, that is, if its ſide is $\frac{1}{10}$ of an inch, the time of completely filling the hogſhead will be 173″ very nearly, or ſomething leſs than three minutes.

If we make the experiment with a hole cut in a thin plate, we ſhall find the time greater nearly in the proportion of 63 to 100, for reaſons obvious to all who have ſtudied hydraulics. In like manner we can tell the time neceſſary for bringing the air in the veſſel to $\frac{3}{4}$ of its ordinary denſity. The only variable part of our fluent is the coefficient $-\sqrt{D-\delta}$, or $\sqrt{1-\delta}$. Let δ be $=\frac{3}{4}$, then $\sqrt{1-\delta}=\sqrt{\frac{1}{4}}=\frac{1}{2}$, and $1-\sqrt{1-\delta}=\frac{1}{2}$; and the time is $86\frac{1}{2}''$ very nearly when the hole is $\frac{1}{10}$ of an inch wide.

Plate CCCCV.

287 The velocity of air with the additional impulſe of a weight moving down the veſſel.

Let us now ſuppoſe that the air in the veſſel ABCD (fig. 64.) is compreſſed by a weight acting on the cover AD, which is moveable down the veſſel, and is thus expelled into the external air.

The immediate effect of this external preſſure is to compreſs the air and give it another denſity. The denſity D of the external air correſponds to its preſſure P. Let the additional preſſure on the cover of the veſſel be p, and the denſity of the air in the veſſel be d. We ſhall have $P:P+p=D:d$; and therefore $p=P\times\frac{d-D}{D}$. Then, becauſe the preſſure which expels the air is the difference between the force which compreſſes the air in the veſſel and the force which compreſſes the external air, the expelling force is p. And becauſe the quantities of motion are as the forces which ſimilarly produce them; we ſhall have $P:P\times\frac{d-D}{D}=MV:mv$; where M and m expreſs the quantities of matter expelled, V expreſſes the velocity with which air ruſhes into a void, and v expreſſes the velocity ſought. But becauſe the quantities of aerial matter which iſſue from the ſame orifice in a moment are as the denſities and velocities jointly, we ſhall have $MV:mv=DVV:dvv, =DV^2:dv^2$. Therefore $P:p\frac{d-D}{D}=DV^2:dv$. Hence we deduce

$$v=V\sqrt{\frac{d-D}{d}}.$$

We may have another expreſſion of the velocity without conſidering the denſity. We had $P:P+p=D:d$: therefore $d=\frac{D\times\overline{P+p}}{P}$, and $d-D=\frac{D\times\overline{P+p}}{P}-D$, $=\frac{D\times\overline{P+p}-DP}{P}$, and, $\frac{d-D}{d}=\frac{D\times\overline{P+p}-DP}{D\times P+p}$, $=\frac{P+p-P}{P+p}, =\frac{p}{P+p}$. therefore $v=V\times\sqrt{\frac{p}{P+p}}$, which is a very ſimple and convenient expreſſion.

288 The effect of the air's elaſticity conſidered.

Hitherto we have conſidered the motion of air as produced by its weight only. Let us now conſider the effect of its elaſticity.

Let ABCD (fig. 64.) be a veſſel containing air of any denſity D. This air is in a ſtate of compreſſion; and if the compreſſing force be removed, it will expand, and its elaſticity will diminiſh along with its denſity.

Its elaſticity in any ſtate is meaſured by the force which keeps it in that ſtate. The force which keeps common air in its ordinary denſity is the weight of the atmoſphere, and is the ſame with the weight of a column of water 33 feet high. If therefore we ſuppoſe that this air, inſtead of being confined by the top of the veſſel, is preſſed down by a moveable piſton carrying a column of water 33 feet high, its elaſticity will balance this preſſure as it balances the preſſure of the atmoſphere; and as it is a fluid, and propagates through every part the preſſure exerted on any one part, it will preſs on any little portion of the veſſel by its elaſticity in the ſame manner as when loaded with this column.

The conſequence of this reaſoning is, that if this ſmall portion of the veſſel be removed, and thus a paſſage be made into a void, the air will begin to flow out with the ſame velocity with which it would flow when impelled by its weight alone, or with the velocity acquired by falling from the top of a homogeneous atmoſphere, or 1332 feet in a ſecond nearly.

But as ſoon as ſome air has come out, the denſity of the remaining air is diminiſhed, and its elaſticity is diminiſhed; therefore the expelling force is diminiſhed. But the matter to be moved is diminiſhed in the very ſame proportion, becauſe the denſity and elaſticity are found to vary according to the ſame law; therefore the velocity will continue the ſame from the beginning to the end of the efflux.

This may be ſeen in another way. Let P be the preſſure of the atmoſphere, which being the counter-balance and meaſure of the initial elaſticity, is equal to the expelling force at the firſt inſtant. Let D be the initial denſity, and V the initial velocity. Let d be its denſity at the end of the time t of efflux, and v the contemporaneous velocity. It is plain that at the end of this time we ſhall have the expelling force $\pi = \frac{Pd}{D}$; for $D : d = P : \pi \left(= \frac{Pd}{D} \right)$.

Theſe forces are proportional to the quantities of motion which they produce; and the quantities of motion are proportional to the quantities of matter M and m and the velocities V and v jointly: therefore we have $P : \frac{Pd}{D} = MV : mv$. But the quantities of matter which eſcape through a given orifice are as the denſities and velocities jointly; that is, $M : m = DV : dv$: therefore $P : \frac{Pd}{D} = DV^2 : dv^2$, and $P \times dv^2 = \frac{PdDV^2}{D} = PdV^2$, and $V^2 = v^2$, and $V = v$, and the velocity of efflux is conſtant. Hence follows, what appears very unlikely at firſt ſight, that however much the air in the veſſel is condenſed, it will always iſſue into a void with the ſame velocity.

289 Quantity of air iſſuing into a void in a given time, and the denſity at the end of that time

In order to find the quantity of aerial matter which will iſſue during any time t, and conſequently the denſity of the remaining air at the end of this time, we muſt get the rate of efflux. In the element of time $\dot t$ there iſſues (by what has been ſaid above) the bulk $8\sqrt{HO}t$ (for the velocity V is conſtant); and therefore the quantity $8\sqrt{HO}\,d\dot t$. On the other hand, the quantity of air at the beginning was CD, C being the capacity of the veſſel; and when the air has acquired the denſity d, the quantity is Cd, and the quantity run out is $CD - Cd$: therefore the quantity which has run out in the time $\dot t$ muſt be the fluxion of $CD - Cd$, or $-C\dot d$. Therefore we have the equation $8\sqrt{HO}\,d\dot t = -C\dot d$, and $\dot t = \frac{-C\dot d}{8\sqrt{HO}d}$; $= \frac{C}{8\sqrt{HO}} \times -\frac{\dot d}{d}$.

The fluent of this is $t = \frac{C}{8\sqrt{HO}} \log. d$. This fluent muſt be ſo taken that t may be $= 0$ when $d = D$. Therefore the correct fluent will be $t = \frac{C}{8\sqrt{HO}} \log. \frac{D}{d}$, for $\log. \frac{D}{D} = \log. 1, = 0$. We deduce from this, that it requires an infinite time for the whole air of a veſſel to flow out of it into a void. N. B. By log. d, &c. is meant the hyperbolic logarithm of d, &c.

290 When the veſſel emits it into rarer air.

Let us next ſuppoſe that the veſſel, inſtead of letting out its air into a void, emits it into air of a leſs denſity, which remains conſtant during the efflux, as we may ſuppoſe to be the caſe when a veſſel containing condenſed air emits it into the ſurrounding atmoſphere. Let the initial denſity of the air in the veſſel be δ, and that of the atmoſphere D. Then it is plain that the expelling force is $P - \frac{PD}{\delta}$, and that after the time t it is $\frac{Pd}{\delta} - \frac{PD}{\delta}$. We have therefore $P - \frac{PD}{\delta} : \frac{Pd}{\delta} - \frac{PD}{\delta} = MV : mv, = \delta V^2 : dv^2$. Whence we derive $v = V\sqrt{\frac{\delta d - D}{d\delta - D}}$

From this equation we learn that the motion will be at an end when $d = D$: and if $\delta = D$ there can be no efflux.

291 Relation between the time and denſity when iſſuing into a void.

To find the relation between the time and the denſity, let H as before be the height producing the velocity V. The height producing the velocity of efflux v muſt be $H \times \frac{\delta d - D}{d\delta - D}$, and the little parcel of air which will flow out in the time $\dot t$ will be $= 8\sqrt{HO}\,d\dot t \sqrt{\frac{\delta d - D}{d\delta - D}}$. On the other hand, it is $= -C\dot d$.

Hence we deduce this fluxionary equation $\dot t = \frac{C\sqrt{\delta - D}}{8\sqrt{HO}\sqrt{\delta}} \times \frac{-\dot d}{\sqrt{\delta^2 - Dd}}$. The fluent of this, corrected ſo as to make $t = 0$ when $d = \delta$, is $t = \frac{C\sqrt{\delta - D}}{8\sqrt{HO}\sqrt{\delta}} \times \log. \left(\frac{\delta - \frac{1}{2}D + \sqrt{\delta^2 - D\delta}}{d - \frac{1}{2}D + \sqrt{d^2 - D\delta}} \right)$. And the time of completing the efflux, when $d = D$, is $t = \frac{C\sqrt{\delta - D}}{8\sqrt{HO}\sqrt{\delta}} \times \log. \left(\frac{\delta - \frac{1}{2}D + \sqrt{\delta^2 - D\delta}}{\frac{1}{2}D} \right)$.

Plate CCCCV. 292 When iſſuing from denſer into rarer air.

Laſtly, let ABCD, CFGH (fig. 65.) be two veſſels containing airs of different denſities, and communicating by the orifice C, there will be a current from the veſſel containing the denſer air into that containing the rarer: ſuppoſe from ABCD into CFGH.

Let P be the elaſtic force of the air in ABCD, Q its denſity, and V its velocity, and D the denſity of the air in CFGH. And, after the time t, let the denſity of the air in ABCD be q, its velocity v, and the denſity of the air in CFGH be δ. The expelling force from ABCD will be $P-\frac{PD}{Q}$ at the firſt inſtant, and at the end of the time t it will be $\frac{Pq}{Q}-\frac{P\delta}{Q}$. Therefore we ſhall have $P-\frac{PD}{Q}:\frac{Pq}{Q}-\frac{P\delta}{Q}=QV^2:qv^2$, which gives $v=V\times\sqrt{\frac{Q(q-\delta)}{q(Q-D)}}$, and the motion will ceaſe when $\delta=q$.

Let A be the capacity of the firſt veſſel, and B that of the ſecond. We have the ſecond equation $AQ+BD=Aq+B\delta$ and therefore $\delta=\frac{A(Q-q)+BD.}{B}$ Subſtituting this value of δ in the former value of v, we have $v=V\times\sqrt{\frac{Q[B(q-D)-A(Q-q)]}{qB(Q-D)}}$, which gives the relation between the velocity v and the denſity q.

In order to aſcertain the time when the air in ABCD has acquired the denſity q, it will be convenient to abridge the work by ſome ſubſtitutions. Therefore make $Q(B+A)=M$, $BQD+BQ^2=N$, $BQ-BD=R$ and $\frac{N}{M}=m$. Then, proceeding as before, we obtain the fluxionary equation

$$8\sqrt{HO}q\frac{\sqrt{Mq-N}\,\dot{t}}{\sqrt{R}\sqrt{q}}=\overline{AQ-Aq}=-A\dot{q}$$

whence

$$\dot{t}=\frac{A\sqrt{R}}{8\sqrt{HO}\sqrt{M}}\times\frac{\dot{q}}{\sqrt{q^2-mq}}$$

of which the fluent, completed ſo that $t=0$ when $=Q$, is

$$t=\frac{A\sqrt{R}}{8\sqrt{HO}\sqrt{M}}\times\text{Log.}\left(\frac{Q-\tfrac{1}{2}m+\sqrt{(Q^2mQ)}}{q-\tfrac{1}{2}m+\sqrt{(q^2mq)}}\right)$$

293 When air is expelled by force, as in bellows.

Some of theſe queſtions are of difficult ſolution, and they are not of frequent uſe in the more important and uſual applications of the doctrines of pneumatics, at leaſt in their preſent form. The caſes of greateſt uſe are when the air is expelled from a veſſel by an external force, as when bellows are worked, whether of the ordinary form or conſiſting of a cylinder fitted with a moveable piſton. This laſt caſe merits a particular conſideration; and, fortunately, the inveſtigation is extremely eaſy.

Plate CCCCV.

Let AD fig. 64. be conſidered as a piſton moving downward with the uniform velocity f, and let the area of the piſton be n times the area of the hole of efflux, then the velocity of efflux ariſing from the motion, of the piſton will be nf. Add this to the velocity V produced by the elaſticity of the air in the firſt queſtion, and the whole velocity will be $V+nf$. It will be the ſame in the others. The problem is alſo freed from the conſideration of the time of efflux. For this depends now on the velocity of the piſton. It is ſtill, however, a very intricate problem to aſcertain the relation between the time and the denſity, even though the piſton is moving uniformly; for at the beginning of the motion the air is of common denſity. As the piſton deſcends, it both expels and compreſſes the air, and the denſity of the air in the veſſel varies in a very intricate manner, as alſo its reſiſtance or reaction on the piſton. For this reaſon, a piſton which moves uniformly by means of an external force will never make an uniform blaſt by ſucceſſive ſtrokes; it will always be weaker at the beginning of the ſtroke. The beſt way for ſecuring an uniform blaſt is to employ the external force only for lifting up the piſton, and then to let the piſton deſcend by its own weight. In this way it will quickly ſink down, compreſſing the air, till its denſity and correſponding elaſticity exactly balance the weight of the piſton. After this the piſton will deſcend equably, and the blaſt will be uniform. We ſhall have occaſion to conſider this more particularly under the head of *Pneumatical Machines*. Theſe obſervations and theorems will ſerve to determine the initial velocity of the air in all important caſes of its expulſion. The philoſopher will learn the rate of its efflux out of one veſſel into another; the chemiſt will be able to calculate the quantities of the different gaſes which are employed in the curious experiments of the ingenious but unfortunate Lavoiſier on Combuſtion, and will find them extremely different from what he ſuppoſed; the engineer will learn how to proportion the motive force of his machine to the quantity of aerial matter which his bellows muſt ſupply. But it is not enough, for this purpoſe, that the air *begin* to iſſue in the proper quantity; we muſt ſee whether it be not affected by the circumſtances of its ſubſequent paſſage.

294 Paſſage of air through pipes, &c. ſimilar to the motion of water in conduits.

All the modifications of motion which are obſerved in water conduits take place alſo in the paſſage of air through pipes and holes of all kinds. There is the ſame diminution of quantity paſſing through a hole in a thin plate that is obſerved in water. We know that (abating the ſmall effect of friction) water iſſues with the velocity acquired by falling from the ſurface; and yet if we calculate by this velocity and by the area of the orifice we ſhall find the quantity of water deficient nearly in the proportion of 63 to 100. This is owing to the water preſſing towards the orifice from all ſides, which occaſions the contraction of the jet. The ſame thing happens in the efflux of air. Alſo the motion of water is greatly impeded by all contractions of its paſſage. Theſe oblige it to accelerate its velocity, and therefore require an increaſe of preſſure to force it through them, and this in proportion to the ſquares of the velocities. Thus, if a machine working a pump cauſes it to give a certain number of ſtrokes in a minute, it will deliver a determined quantity of water in that time. Should it happen that the paſſage of the water is contracted to one half in any part of the machine (a thing which frequently happens at the valves), the water muſt move through this contraction with twice the velocity that it has in the reſt of the paſſage. This will require four times the force to be exerted on the piſton. Nay (which will appear very odd, and is never ſuſpected by engineers), if no part of the paſſage is narrower than the barrel of the pump, but on the contrary a part much wider, and if the conduit be again contracted to the width of the barrel, an additional force muſt be applied to the piſton to drive the water through this paſſage, which would not have been neceſſary if the paſſage had not been widened in any part. It will require a force equal to the weight of a column of water of the height neceſſary for communicating a velocity the ſquare of which is equal to the difference of the ſquares of the velocities of the water in the wide and the narrow part of the conduit.

The ſame thing takes place in the motion of air, and therefore all contractions and dilatations muſt be carefully avoided, when we want to preſerve the velocity unimpaired.

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Air ſuffers the ſame retardation along pipes as water, and the neceſſity of attending to this.

Air alſo ſuffers the ſame retardation in its motion along pipes. By not knowing, or not attending to that, engineers of the firſt reputation have been prodigiouſly diſappointed in their expectations of the quantity of air which will be delivered by long pipes. Its extreme mobility and lightneſs hindered them from ſuſpecting that it would ſuffer any ſenſible retardation. Dr Papin, a moſt ingenious man, propoſed this as the moſt effectual method of transferring the action of a moving power to a great diſtance. Suppoſe, for inſtance, that it was required to raiſe water out of a mine by a water-machine, and that there was no fall of water nearer than a mile's diſtance. He employed this water to drive a piſton, which ſhould compreſs the air in a cylinder communicating, by a long pipe, with another cylinder at the mouth of the mine. This ſecond cylinder had a piſton in it, whoſe rod was to give motion to the pumps at the mine. He expected, that as ſoon as the piſton at the water-machine had compreſſed the air ſufficiently, it would cauſe the air in the cylinder at the mine to force up its piſton, and thus work the pumps. Doctor Hooke made many objections to the method, when laid before the Royal Society, and it was much debated there. But dynamics was at this time an infant ſcience, and very little underſtood. Newton had not then taken any part in the buſineſs of the ſociety, otherwiſe the true objections would not have eſcaped his ſagacious mind. Notwithſtanding Papin's great reputation as an engineer and mechanic, he could not bring his ſcheme into uſe in England; but afterwards, in France and in Germany, where he ſettled, he got ſome perſons of great fortunes to employ him in this project; and he erected great machines in Auvergne and Weſtphalia for draining mines. But, ſo far from being effective machines, they would not even begin to move. He attributed the failure to the quantity of air in the pipe of communication, which muſt be condenſed before it can condenſe the air in the remote cylinder. This indeed is true, and he ſhould have thought of this earlier. He therefore diminiſhed the ſize of this pipe, and made his water machine exhauſt inſtead of condenſing, and had no doubt but that the immenſe velocity with which air ruſhes into a void would make a rapid and effectual communication of power. But he was equally diſappointed here, and the machine at the mine ſtood ſtill as before.

Near a century after this, a very intelligent engineer attempted a much more feaſible thing of this kind at an iron-foundery in Wales. He erected a machine at a powerful fall of water, which worked a ſet of cylinder bellows, the blow-pipe of which was conducted to the diſtance of a mile and a half, where it was applied to a blaſt furnace. But notwithſtanding every care to make the conducting pipe very air tight, of great ſize, and as ſmooth as poſſible, it would hardly blow out a candle. The failure was aſcribed to the impoſſibility of making the pipe air-tight. But, what was ſurpriſing, above ten minutes elapſed after the action of the piſtons in the bellows before the leaſt wind could be perceived at the end of the pipe; whereas the engineer expected an interval of 6 ſeconds only.

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No diſtinct theory on this ſubject.

No very diſtinct theory can be delivered on this ſubject; but we may derive conſiderable aſſiſtance in underſtanding the cauſes of the obſtruction to the motion of water in long pipes, by conſidering what happens to air. The elaſticity of the air, and its great compreſſibility, have given us the diſtincteſt notions of fluidity in general, ſhowing us, in a way that can hardly be controverted, that the particles of a fluid are kept at a diſtance from each other, and from other bodies, by the corpuſcular forces. We ſhall therefore take this opportunity to give a view of the ſubject, which did not occur to us when treating of the motion of water in pipes, reſerving a further diſcuſſion to the articles River, *Water-Works*.

296
How fluids are obſtructed in moving along canals.

The writers on hydrodynamics have always conſidered the obſtruction to the motion of fluids along canals of any kind, as owing to ſomething like the friction by which the motion of ſolid bodies on each other is obſtructed; but we cannot form to ourſelves any diſtinct notion of reſemblance, or even analogy between them. The fact is, however, that a fluid running along a canal has its motion obſtructed; and that this obſtruction is greateſt in the immediate vicinity of the ſolid canal, and gradually diminiſhes to the middle of the ſtream. It appears, therefore, that the parts of fluids can no more move among each other than among ſolid bodies, without ſuffering a diminution of their motion. The parts in phyſical contact with the ſides and bottom are retarded by theſe immoveable bodies. The particles of the next ſtratum of fluid cannot preſerve their initial velocities without overpaſſing the particles of the firſt ſtratum; and it appears from the fact that they are by this means retarded. They retard in the ſame manner the particles of the third ſtratum, and ſo on to the middle ſtratum or thread of fluid. It appears from the fact, therefore, that this ſort of friction is not a conſequence of rigidity alone, but that it is equally competent to fluids. Nay, ſince it is a matter of fact in air, and is even more remarkable there than in any other fluid, as we ſhall ſee by the experiments which have been made on the ſubject; and as our experiments on the compreſſion of air ſhow us the particles of air ten times nearer to each other in ſome caſes than in others (viz. when we ſee air a thouſand times denſer in theſe caſes), and therefore force us to acknowledge that they are not in contact; it it is plain that this obſtruction has no analogy to friction, which ſuppoſes roughneſs or inequality of ſurface. No ſuch inequality can be ſuppoſed in the ſurface of an aerial particle; nor would it be of any ſervice in explaining the obſtruction, ſince the particles do not rub on each other, but paſs each other at ſome ſmall and imperceptible diſtance.

We muſt therefore have recourſe to ſome other mode of explication. We ſhall apply this to air only in this place; and, ſince it is proved by the uncontrovertible experiments of Canton, Zimmerman, and others, that water, mercury, oil, &c. are alſo compreſſible and perfectly elaſtic, the argument from this principle, which is concluſive in air, muſt equally explain the ſimilar phenomenon in hydraulics.

The moſt highly poliſhed body which we know muſt be conceived as having an uneven ſurface when we compare it with the ſmall ſpaces in which the corpuſcular forces are exerted; and a quantity of air moving in a poliſhed pipe may be compared to a quantity of ſmall ſhot ſliding down a channel with undulated ſides and bottom. The row of particles immediately contiguous to the ſides will therefore have an undulated motion: but this undulation of the contiguous particles of air will not be ſo great as that of the ſurface along which they glide; for not only every motion requires force to produce it, but alſo every change of motion.

297 Particles of air reſiſt a change from a rectilineal to an undulating motion,

The particles of air reſiſt this change from a rectilineal to an undulating motion; and, being elaſtic, that is, repelling each other and other bodies, they keep a little nearer to the ſurface as they are paſſing over an eminence, and their path is leſs incurvated than the ſurface. The difference between the motion of the particles of air and the particles of a fluid quite unelaſtic is, in this reſpect, ſomewhat like the difference between the motion of a ſpring-carriage and that of a common carriage. When the common carriage paſſes along a road not perfectly ſmooth, the line deſcribed by the centre of gravity of the carriage keeps perfectly parallel to that deſcribed by the axis of the wheels, riſing and falling along with it. Now let a ſpring body be put on the ſame wheels and paſs along the ſame road. When the axis riſes over an eminence perhaps half an inch, ſinks down again into the next hollow, and then riſes a ſecond time, and ſo on, the centre of gravity of the body deſcribes a much ſtraighter line; for upon the riſing of the wheels, the body reſiſts the motion, and compreſſes the ſprings, and thus remains lower than it would have been had the ſprings not been interpoſed. In like manner, it does not ſink ſo low as the axle does when the wheels go into a hollow. And thus the motion of ſpring-carriages becomes leſs violently undulated than the road along which they paſs. This illuſtration will, we hope, enable the reader to conceive how the deviation of the particles next to the ſides and bottom of the canal from a rectilineal motion is leſs than that of the canal itſelf.

298 And the undulation of the ſecond row of particles will be leſs than that of the firſt.

It is evident that the ſame reaſoning will prove that the undulation of the next row of particles will be leſs than that of the firſt, that the undulation of the third row will be leſs than that of the ſecond, and ſo on, as is repreſented in fig. A. Plate CCCCV. And thus it appears, that while the maſs of air has a progreſſive motion along the pipe or canal, each particle is deſcribing a waving line, of which a line parallel to the direction of the canal is the axis, cutting all theſe undulations. This axis of each undulated path will be ſtraight or curved as the canal is, and the excurſions of the path on each ſide of its axis will be leſs and leſs as the axis of the path is nearer to the axis of the canal.

299 Each particle appears to loſe no velocity.

Let us now ſee what *ſenſible* effect this will have; for all the motion which we here ſpeak of is imperceptible. It is demonſtrated in mechanics, that if a body moving with any velocity be deflected from its rectilineal path by a curved and perfectly ſmooth channel, to which the rectilineal path is a tangent, it will proceed along this channel with undiminiſhed velocity. Now the path, in the preſent caſe, may be conſidered as perfectly ſmooth, ſince the particles do not touch it. It is one of the undulations which we are conſidering, and we may at preſent conceive this as without any ſubordinate inequalities. There ſhould not, therefore, be any diminution of the velocity. Let us grant this of the abſolute velocity of the particle; but what we obſerve is the velocity of the maſs, and we judge of it perhaps by the motion of a feather carried along by it. Let us ſuppoſe a ſingle atom to be a ſenſible object and let us attend to two ſuch particles, one at the ſide, and the other in the middle: although we cannot perceive the undulations of theſe particles during their progreſſive motions, we ſee the progreſſive motions themſelves. Let us ſuppoſe then that the middle particle has moved without any undulation whatever, and that it has advanced ten feet. The lateral particle will alſo have moved ten feet; but this has not been in a ſtraight line. It will not be ſo far advanced, therefore, in the direction of the canal; it will be left behind, and will appear to us to have been retarded in its motion: and in like manner each thread of particles will be more and more retarded (apparently only) as it recedes farther from the axis of the canal, or what is uſually called the thread of the ſtream.

300 But on the whole the undulatory motion is a real obſtruction.

And thus the obſerved fact is ſhown to be a neceſſary conſequence of what we know to be the nature of a compreſſible or elaſtic fluid; and that without ſuppoſing any diminution in the real velocity of each particle, there will be a diminution of the velocity of the ſenſible threads of the general ſtream and a diminution of the whole quantity of air which paſſes along it durig a given time.

Let us now ſuppoſe a parcel of air impelled along a pipe, which is *perfectly* ſmooth, out of a larger veſſel, and iſſuing from this pipe with a certain velocity. It requires a certain force to change its velocity in the veſſel to the greater velocity which it has in the pipe. This is abundantly demonſtrated. How long ſoever we ſuppoſe this pipe, there will be no change in the velocity, or in the force to keep it up. But let us ſuppoſe that about the middle of this pipe there is a part of it which has ſuddenly got an undulated ſurface however imperceptible. Let us further ſuppoſe that the final velocity of the middle thread is the ſame as before. In this caſe it is evident that the ſum total of the motions of all the particles is greater than before becauſe the abſolute motions of the lateral particles is greater than that of the central particle, which we ſuppoſe the ſame as before. This abſolute increaſe of motion cannot be without an increaſe of propelling force: the force acting now, therefore, muſt be greater than the force acting formerly. Therefore, if only the former force had continued to act, the ſame motion of the central particle could not have been preſerved, or the progreſſive motion of the whole ſtream muſt be diminiſhed.

And thus we ſee that the internal inſenſible undulatory motion becomes a real obſtruction to the ſenſible motion which we obſerve, and occaſions an expence of power.

301 An additional force neceſſary for preſerving a given progreſſive motion,

Let us ſee what will be the conſequence of extending this obſtructing ſurface further along the canal. It muſt evidently be accompanied by an augmentation of the motion produced, if the central velocity be ſtill kept up; for the particles which are now in contact with the ſides do not continue to occupy that ſituation: the middle particles moving faſter *forward* get over them, and in their turn come next the ſide; and as they are really moving equally faſt, but not in the direction into which they are now to be forced, force is neceſſary for changing the direction alſo; and this is in addition to the force neceſſary for producing the undulations ſo minutely treated of. The conſequence of this muſt be, that an additional force will be neceſſary for preſerving a given progreſſive motion in a longer *obſtructing* pipe, and that the motion produced in a pipe of greater length by a given force will be leſs than in a ſhorter one, and the efflux will be diminiſhed.

302 Eſpecially through any contraction.

There is another conſideration which muſt have an influence here. Nothing is more irrefragably demonſtrated than the neceſſity of an additional force for producing an efflux through any contraction, even though it ſhould be ſucceeded by a dilatation of the paſſage. Now both the inequalities of the ſides and the undulations of the motions of each particle are equivalent to a ſucceſſion of contractions and dilatations; although each of theſe is next to infinitely ſmall; their number is alſo next to infinitely great, and therefore the total effect may be ſenſible.

303 There are beſides other obſtructions, as angular aſperities, &c.

We have hitherto ſuppoſed that the abſolute velocity of the particles was not diminiſhed: this we did, having aſſumed that the interval of each undulation of the ſides was without inequalities. But this was gratuitous: it was alſo gratuitous that the ſides were only undulated. We have no reaſon for excluding angular aſperities. Theſe will produce, and moſt certainly often produce, real diminutions in the velocity of the contiguous particles; and this muſt extend to the very axis of the canal, and produce a diminution of the ſum total of motion: and in order to preſerve the ſame ſenſible progreſſive motion, a greater force muſt be employed. This is all that can be meant by ſaying that there is a reſiſtance to the motion of air through long pipes.

304 And a want of perfect fluidity.

There remains another cauſe of diminution, viz. the want of perfect fluidity, whether ariſing from the diſſemination of ſolid particles in a real fluid, or from the viſcidity of the fluid. We ſhall not inſiſt on this at preſent, becauſe it cannot be ſhown to obtain in air, at leaſt in any caſe which deſerves conſideration. It ſeems of no importance to determine the motion of air hurrying along with it ſoot or duſt. The effect of fogs on a particular modification of the motion of air will be conſidered under the article Sound. What has been ſaid on this ſubject is ſufficient for our purpoſe, as explaining the prodigious and unexpected obſtruction to the paſſage of air through long and narrow pipes. We are able to collect an important maxim from it, viz. that all pipes of communication ſhould be made as wide as circumſtances will permit: for it is plain that the obſtruction depends on the internal ſurface, and the force to overcome it muſt be in proportion to the maſs of matter which is in motion. The firſt increaſes as the diameter of the pipe, and the laſt as the ſquare. The obſtruction muſt therefore bear a greater proportion to the whole motion in a ſmall pipe than in a large one.

305 The law of retardation extending from the axis to the ſides of the canal unknown.

It were very deſirable to know the law by which the retardation extends from the axis to the ſides of the canal, and the proportion which ſubſiſts between the lengths of canal and the forces neceſſary for overcoming the obſtructions when the velocity is given; as alſo whether the proportion of the obſtruction to the whole motion varies with the velocity: but all this is unknown. It does not, however, ſeem, a deſperate caſe in air: we know pretty diſtinctly the law of action among its particles viz. that their mutual repulſions are inverſely as their diſtances. This promiſes to enable us to trace the progreſs of undulation from the ſides of the canal to the axis.

306 It will not increaſe ſo faſt as the ſquare of the velocities.

We can ſee that the retardations will not increaſe ſo faſt as the ſquare of the velocity. Were the fluid incompreſſible ſo that the undulatory path of a particle were invariable, the deflecting forces by which each individual particle is made to deſcribe its undulating path would be preciſely ſuch as ariſe from the path itſelf and the motion in it; for each particle would be in the ſituation of a body moving along a fixed path. But in a very compreſſible fluid, ſuch as air, each particle may be conſidered as a ſolitary body, actuated by a projectile and a tranſverſe force, ariſing from the action of the adjoining particles. Its motion muſt depend on the adjuſtment of theſe forces, in the ſame manner as the elliptical motion of a planet depends on the adjuſtment of the force of projection, with a gravitation inverſely proportional to the ſquare of the diſtance from the focus. The tranſverſe force in the preſent caſe has its origin in the preſſure on the air which is propelling it along the pipe: this, by ſqueezing the particles together, brings their mutual repulſion into action. Now it is the property of a perfect fluid, that a preſſure exerted on any part of it is propagated equally through the whole fluid, therefore the tranſverſe forces which are excited by this preſſure are proportional to the preſſure itſelf: and we know that the preſſures exerted on the ſurface of a fluid. ſo as to expel it through any orifice, or along any canal, are proportional to the ſquares of the velocities which they produce. Therefore, in every point of the undulatory motion of any particle, the tranſverſe force by which it is deflected into a curve is proportional to the ſquare of its velocity. When this is the caſe, a body would continue to deſcribe the ſame curve as before; but, by the very compreſſion, the curvatures are increaſed, ſuppoſing them to remain ſimilar. This would require an increaſe of the tranſverſe forces; but this is not to be found: therefore the particle will not deſcribe a ſimilar curve, but one which is leſs incurvated in all its parts; conſequently the progreſſive velocity of the whole, which is the only thing perceivable by us, will not be ſo much diminiſhed; that is, the obſtructions will not increaſe ſo faſt as they would otherwiſe do, or as the ſquares of the velocities.

This reaſoning is equally applicable to all fluids, and is abundantly confirmed by experiments in hydraulics, as we ſhall ſee when conſidering the motion of rivers. We have taken this opportunity of delivering our notions on this ſubject; becauſe, as we have often ſaid, it is in the avowed diſcrete conſtitution of air that we ſee moſt diſtinctly the operation of thoſe natural powers which conſtitute fluidity in general,

307 M. Boſſut's experiment on pipes and canals.

We would beg leave to mention a form of experiment for diſcovering the law of retardation with conſiderable accuracy. Experiments have been made on pipes and canals. Mr Boſſut, in his *Hydrodynamique*, has given a very beautiful ſet made on pipes of an inch and two inches diameter, and 200 feet long: but although theſe experiments are very inſtructive, they do not give us any rule by which we can extend the reſult to pipes of greater length and different diameters.

Plate CCCCV.

Let a ſmooth cylinder be ſet upright in a very large veſſel or pond, and be moveable round its axis: let it be turned round by means of a wheel and pulley with an uniform motion and determined velocity. It will exert the ſame force on the contiguous water which would be exerted on it by water turning round it with the ſame velocity: and as this water would have its motion gradually retarded by the fixed cylinder, ſo the moving cylinder will gradually communicate motion to the ſurrounding water. We ſhould obſerve the water gradually dragged round by it; and the vortex would extend farther and farther from it as the motion is continued, and the velocities of the parts of the vortex will be leſs and leſs as we recede from the axis. Now, we apprehend, that when a point of the ſurface of the cylinder has moved over 200 feet, the *motion* of the water at different diſtances from it will be ſimilar and proportional to, if not preciſely the ſame with, the *retardations* of water flowing 200 feet at the ſame diſtance from the ſide of a canal: at any rate, the two are ſuſceptible of an accurate compariſon, and the law of retardation may be accurately deduced from obſervations made on the motions of this vortex.

308
Wind is air in motion.

Air in motion is a very familiar object of obſervation; and it is intereſting. In all languages it has got a name; we call it wind: and it is only upon reflection that we conſider air as wind in a quieſcent ſtate. Many perſons hardly know what is meant when air is mentioned; but they cannot refuſe that the blaſt from a bellows is the expulſion of what they contained; and thus they learn that the wind is air in motion.

309
The velocity of wind not eaſily diſcovered.

It is of conſequence to know the velocity of wind; but no good and unexceptionable method has been contrived for this purpoſe. The beſt ſeems to be by meaſuring the ſpace paſſed over by the ſhadow of a cloud; but this is extremely fallacious. In the firſt place, it is certain, that although we ſuppoſe that the cloud has the velocity of the air in which it is carried along, this is not an exact meaſure of the current on the ſurface of the earth; we may be almoſt certain that it is greater: for air, like all other fluids, is retarded by the ſides and bottom of the channel in which it moves. But, in the next place, it is very gratuitous to ſuppoſe, that the velocity of the cloud is the velocity of the ſtratum of air between the cloud and the earth; we are almoſt certain that it is not. It is abundantly proved by Dr Hutton of Edinburgh, that clouds are always formed when two parcels of air of different temperatures mix together, each containing a proper quantity of vapour in the ſtate of chemical ſolution. We know that different ſtrata of air will frequently flow in different directions for a long time. In 1781 while a great fleet rendezvouzed in Leith Roads during the Dutch war, there was a briſk eaſterly wind for about five weeks; and, during the laſt fortnight of this period, there was a briſk weſterly current at the height of about ¼ of a mile. This was diſtinctly indicated by frequent fleecy clouds at a great diſtance above a lower ſtratum of theſe clouds, which were driving all this time from the eaſtward. A gentleman who was at the ſiege of Quebec in 1759, informed us, that one day while there blew a gale from the weſt, ſo hard that the ſhips at anchor in the river were obliged to ſtrike their topmaſts, and it was with the utmoſt difficulty that ſome well manned boats could row againſt it, carrying ſome artillery ſtores to a poſt above the town, ſeveral ſhells were thrown from the town to deſtroy the boats: one of the ſhells burſt in the air near the top of its flight, which was about half a mile high. The ſmoke of this bomb remained in the ſame ſpot for above a quarter of an hour, like a great round ball, and gradually diſſipated by diffuſion, without removing many yards from its place. When, therefore, two ſtrata of air come from different quarters, and one of them flows over the other, it will be only in the contiguous ſurfaces that a precipitation of vapour will be made. This will form a thin fleecy cloud; and it will have a velocity and direction which neither belongs to the upper nor to the lower ſtratum of air which produced it. Should one of theſe ſtrata come from the eaſt and the other from the weſt with equal velocities, the cloud formed between them will have no motion at all; ſhould one come from the eaſt, and the other from the north, the cloud will move from the north-eaſt with a greater velocity than either of the ſtrata. So uncertain then is the information given by the clouds either of the velocity or the direction of the wind. A thick ſmoke from a furnace will give us a much leſs equivocal meaſure: and this, combined with the effects of the wind in impelling bodies, or deflecting a loaded plane from the perpendicular, or other effects of this kind, may give us meaſures of the different currents of wind with a preciſion ſufficient for all practical uſes.

310
The reſult of Smeaton's obſervation on this head.

The celebrated engineer Mr John Smeaton has given, in the 51ſt volume of the Philoſophical Tranſactions, the velocities of wind correſponding to the uſual denominations in our language. Theſe are founded on a great number of obſervations made by himſelf in the courſe of his practice in erecting wind-mills. They are contained in the following table.

Miles per hour.	Feet per ſecond.	Names.
1	1,47	
2	2,93	Light airs.
3	4,40	
4	5,87	Breeze.
5	7,33	
10	14,67	Briſk gale.
15	22,	
20	29,34	Freſh gale.
25	36,67	
30	44,01	Strong gale.
35	51,34	
40	58,68	Hard gale.
45	66,01	
50	73,35	Storm.
60	88,02	
80	117,36	Hurricane, turning up trees, overturning buildings, &c.
100	146,70	

See alſo ſome valuable experiments by him on this ſubject, Philoſophical Tranſactions 1760 and 1761.

311
Account of Dr Lynd's anemometer.

One of the moſt ingenious and convenient methods for meaſuring the velocity of the wind is to employ its preſſure in ſupporting a column of water, in the ſame way as Mr Pitot meaſures the velocity of a current of water. We believe that it was firſt propoſed by Dr James Lynd of Windſor, a gentleman eminent for his great knowledge in all the branches of natural ſcience, and for his ingenuity in every matter of experiment or practical application.

Plate CCCCV.

His anemometer (as theſe inſtruments are called) conſiſts of a glaſs tube of the form ABCD (fig. 66.), open at both ends, and having the branch AB at right angles to the branch CD. This tube contains a few inches of water or any fluid (the lighter the better); it is held with the part CD upright, and AB horizontal and in the direction of the wind; that is, with the mouth A fronting the wind. The wind acts in the way of preſſure on the air in AB, compreſſes it, and cauſes it to preſs on the ſurface of the liquor; forcing it down to F, while it riſes to E in the other leg. The velocity of the wind is concluded from the difference E*f* between the heights of the liquor in the legs. As the wind does not generally blow with uniform velocity, the liquor is apt to dance in the tube, and render this obſervation difficult and uncertain: to remedy this, it is proper to contract very much the communication at C between the two legs. If the tube has half an inch of diameter (and it ſhould not have leſs), a hole of $\frac{1}{10}$ of an inch is large enough; indeed the hole can hardly be too ſmall, nor the tubes too large.

312
It is ingenious and uſeful.

This inſtrument is extremely ingenious, and will undoubtedly give the proportions of the velocities of different currents with the greateſt preciſion; for in whatever way the preſſure of wind is produced by its motion, we are certain that the different preſſures are as the ſquares of the velocities: if, therefore we can obtain one certain meaſure of the velocity of the wind, and obſerve the degree to which the preſſure produced by it raiſes the liquor, we can at all other times obſerve the preſſures and compute the velocities from them, making proper allowances for the temperature and the height of the mercury in the barometer; becauſe the velocity will be in the ſubduplicate ratio of the denſity of the air inverſely when the preſſure is the ſame.

It is uſually concluded, that the velocity of the wind is that which would be acquired by falling from a height which is to E*f* as the weight of water is to that of an equal bulk of air. Thus, ſuppoſing air to be 840 times lighter than water, and that E*f* is $\frac{9}{10}$ of an inch, the velocity will be about 63 feet *per* ſecond, which is that of a very hard gale, approaching to a ſtorm. Hence we ſee by the bye, that the ſcale of this inſtrument is extremely ſhort, and, that it would be a great improvement of it to make the leg CD not perpendicular, but very much ſloping; or perhaps the following form of the inſtrument will give it all the perfection of which it is capable. Let the horizontal branch AB (fig. 67.) be contracted at B, and continued horizontally for ſeveral inches BG of a much ſmaller bore, and then turned down for two or three inches GC, and then upwards with a wide bore. To uſe the inſtrument, hold it with the part DC perpendicular; and (having ſheltered the mouth A from the wind) pour in water at D till it advances along GB to the point B, which is made the beginning of the ſcale; the water in the upright branch ſtanding at *f* in the ſame horizontal line with BG. Now, turn the mouth A to the wind; the air in AB will be compreſſed and will force the water along BG to F, and cauſe it to riſe from *f* to E; and the range *f* E will be to the range BF on the ſcale as the ſection of the tube BG to that of CD, Thus, if the width of DC be $\frac{1}{2}$ an inch, and that of BG $\frac{1}{10}$, we ſhall have 25 inches in the ſcale for one inch of real preſſure E*f*.

Plate CCCCV.

But it has not been demonſtrated in a very ſatisfactory manner, that the velocity of the wind is that acquired by falling through the height of a column of air whoſe weight is equal to that of the column of water E*f*. Experiments made with Pitot's tube in currents of water ſhow that ſeveral corrections are neceſſary for concluding the velocity of the current from the elevations in the tube: theſe corrections may however be made, and ſafely applied to the preſent caſe; and then the inſtrument will enable us to conclude the velocity of the wind immediately, without any fundamental compariſon of the elevation, with a velocity actually determined upon other principles. The chief uſe which we have for this information is in our employment of wind as an impelling power, by which we can actuate machinary or navigate ſhips. Theſe are very important applications of pneumatical doctrines, and merit a particular conſideration; and this naturally brings us to the laſt part of our ſubject, viz. the conſideration of the impulſe of air on bodies expoſed to its action, and the reſiſtance which it oppoſes to the paſſage of bodies through it.

313
This ſubject is moſt important, but it is alſo difficult.

This is a ſubject of the greateſt importance; being the foundation of that art which has done the greateſt honour to the ingenuity of man, and the greateſt ſervice to human ſociety, by connecting together the moſt diſtant inhabitants of this globe, and making a communication of benefits which would otherwiſe have been impoſſible; we mean the art of Navigation or Seamanſhip. Of all the machines which human art has conſtructed, a ſhip is not only the greateſt and moſt magnificent, but alſo the moſt ingenious and intricate; and the clever ſeaman poſſeſſes a knowledge founded on the moſt difficult and abſtruſe doctrines of mechanics. The ſeaman probably cannot give any account of his own ſcience; and he poſſeſſes it rather by a kind of intuition than by any proceſs of reaſoning: but the ſucceſs and efficacy of all the mechaniſm of this complicated engine, and the propriety of all the manœuvres which the ſeaman practiſes, depend on the invariable laws of mechanics; and a thorough knowledge of theſe would enable an intelligent perſon not only to underſtand the machine and the manner of working it, but to improve both.

Unfortunately this is a ſubject of very great difficulty; and although it has employed the genius of Newton, and he has conſidered it with great care, and his followers have added more to his labours on this ſubject than on any other, it ſtill remains in a very imperfect ſtate.

A minute diſcuſſion of this ſubject cannot therefore be expected in a work like this: we muſt content ourſelves with ſuch a general ſtatement of the moſt approved doctrine on the ſubject as ſhall enable our readers to conceive it diſtinctly, and judge with intelligence and confidence of the practical deductions which may be made from it.

314
Impulſe and reſiſtance of air.

It is evidently a branch of the general theory of the impulſe and reſiſtance of fluids, which ſhould have been treated of under the article Hydraulics, but was then deferred till the mechanical properties of compreſſible fluids ſhould alſo be conſidered. It was thought very reaſonable to ſuppoſe that the circumſtances of elaſticity would introduce the ſame changes in the impulſe and reſiſtance of fluids that it does in ſolid bodies. It would greatly divert the attention from the diſtinctive properties of air, if we ſhould in this place enter on this ſubject, which is both extenſive and difficult. We reckon it better therefore to take the whole together: this we ſhall do under the article *Resistance of Fluids*, and confine ourſelves at preſent to what relates to the impulſe and reſiſtance of air alone; anticipating a few of the general propoſitions of that theory, but without demonſtration, in order to underſtand the applications which may be made of it.

Plate CCCCV.

Suppoſe then a plane ſurface, of which *a* C (fig. 68.) is the ſection, expoſed to the action of a ſtream of wind blowing in the direction QC, perpendicular to *a* C. The motion of the wind will be obſtructed, and the ſurface *a* C preſſed forward. And as all impulſe or preſſure is exerted in a direction perpendicular to the ſurface, and is reſiſted in the oppoſite direction, the ſurface will be impelled in the direction CD, the continuation of QC. And as the mutual actions of bodies depend on their relative motions, the force acting on the ſurface *a* C will be the ſame, if we ſhall ſuppoſe the air at reſt, and the ſurface moving equally ſwift in the oppoſite direction. The reſiſtance of the air to the motion of the body will be equal to the impulſe of the air in the former caſe. Thus reſiſtance and impulſe are equal and contrary.

315 Air moving with a double velocity will generally impel as the ſquare of that velocity.

If the air be moving twice as faſt, its particles will give a double impulſe; but in this caſe a double number of particles will exert their impulſe in the ſame time: the impulſe will therefore be fourfold; and in general it will be as the ſquare of the velocity: or if the air and body be both in motion, the impulſe and reſiſtance will be proportional to the ſquare of the relative velocity.

This is the firſt propoſition on the ſubject, and it appears very conſonant to reaſon. There will therefore be ſome analogy between the force of the air's impulſe or the reſiſtance of a body, and the weight of a column of air incumbent on the ſurface: for it is a principle in the action of fluids, that the heights of the columns of fluid are as the ſquares of the velocities which their preſſures produce. Accordingly the ſecond propoſition is, that the abſolute impulſe of a ſtream of air, blowing perdendicularly on any ſurface, is equal to the weight of a column of air which has that ſurface for its baſe, and for its height the ſpace through which a body muſt fall in order to acquire the velocity of the air.

Thirdly, Suppoſe the ſurface AC equal to *a* C no longer to be perpendicular to the ſtream of air, but inclined to it in the angle ACD, which we ſhall call the *angle of incidence;* then, by the reſolution of forces, it follows, that the action of each particle is diminiſhed in the proportion of radius to the ſine of the angle of incidence, or of AC to AL, AL being perpendicular to CD.

Again: draw AK parallel to CD. It is plain that no air lying farther from CD than KA is will ſtrike the plane. The quantity of impulſe therefore is diminiſhed ſtill farther in the proportion of *a* C to KC, or of AC to AL. Therefore, on the whole, the abſolute impulſe is diminiſhed in the proportion of AC^2 to AL^2: hence the propoſition, that the impulſe and reſiſtance of a given ſurface are in the proportion of the ſquare of the ſine of the angle of incidence.

Fourthly, This impulſe is in the direction PL, perpendicular to the impelled ſurface, and the ſurface tends to move in this direction: but ſuppoſe it moveable only in ſome other direction PO, or that it is in the direction PO that we wiſh to employ this impulſe, its action is therefore oblique; and if we wiſh to know the intenſity of the impulſe in this direction, it muſt be diminiſhed ſtill farther in the proportion of radius to the coſine of the angle LPO or ſine of CPO. Hence the general propoſition: The *effective impulſe is as the ſurface, as the ſquare of the velocity of the wind, as the ſquare of the ſine of the angle of incidence, and as the ſine of the obliquity jointly*, which we may expreſs by the ſymbol $R=S\cdot V^2\cdot \textit{ſin}^2, I\cdot \textit{ſin}.\ O$; and as the impulſe depends on the denſity of the impelling fluid, we may take in every circumſtance by the equation $R=S\cdot D\cdot V^2 .\textit{ſin}.^2 I\cdot \textit{ſin}.\ O$. If the impulſe be eſtimated in the direction of the ſtream, the angle of obliquity ACD is the ſame with the angle of incidence, and the impulſe in this direction is as the ſurface, as the ſquare of the velocity, and as the cube of the angle of incidence jointly

It evidently follows from theſe premiſes, that if ACA be a wedge, of which the baſe AA′ is perpendicular to the wind, and the angle ACA′ biſected by its direction, the direct or perpendicular impulſe on the baſe is to the oblique impulſe on the ſides as radius to the ſquare of the ſine of the half angle ACA′.

The ſame muſt be affirmed of a pyramid or cone ACA′, of which the axis is in the direction of the wind.

If ACA′ (fig. 69.) repreſent the ſection of a ſolid, produced by the revolution of a curve line APC round the axis CD, which lies in the direction of the wind, the impulſe on this body may be compared with the direct impulſe on its baſe, or the reſiſtance to the motion of this body through the air may be compared with the direct reſiſtance of its baſe by reſolving its ſurface into elementary planes P*p*, which are coincident with a tangent plane PR, and comparing the impulſe on P*p* with the direct impulſe on the correſponding part K*k* of the baſe.

In this way it follows that the impulſe on a ſphere is one half of the impulſe on its great circle, or on the baſe of a cylinder of equal diameter.

316 Important inference from this doctrine.

We ſhall conclude this ſketch of the doctrine with a very important propoſition to determine the moſt advantageous poſition of a plane ſurface, when required to move in one direction while it is impelled by the wind blowing in a different direction. Thus,

Let AB (fig. 70.) be the ſail of a ſhip, CA the direction in which the wind blows, and AD the line of the ſhip's courſe it is required to place the yard AC in ſuch a poſition that the impulſe of the wind upon the ſail may have the greateſt effect poſſible in impelling the ſhip along AD.

Let AB, A *b*, be two poſitions of the ſail very near the beſt poſition, but on oppoſite ſides of it. Draw BE, *be*, perpendicular to CA, and BF, *bf*, perpendicular to AD, calling AB radius, it is evident that BE, BF, are the ſines of impulſe and obliquity, and that the effective impulſe is $BE^2\times BF$, or $be^2\times bf$. This muſt be a maximum.

Let the points B, *b*, continually approach and ultimately coincide; the chord *b*B will ultimately coincide with a ſtraight line CBD touching the circle in B; the triangles CBE, *cbe* are ſimilar, as alſo the triangles DBF, D*bf*; therefore $BE^2 : be^2 = BC^2 : bc^2$, and $BF : bf = BD : bD$; and $BE^2\times BF : be^2\times bf = CB^2\times BD : cb^2\times bD$. Therefore when AB is in the beſt poſition, ſo that $BE^2\times BF$ is greater than $be^2\times bf$, we ſhall have $CB\times BD$ greater than $Cb^2\times bD$, or $cB^2\times BD$ is alſo a maximum. This we know to be the caſe when $CB=2BD$: therefore the ſail muſt be ſo placed that the tangent of the angle of incidence ſhall be double of the tangent of the angle of the ſail and keel.

In a common windmill the angle CAD is neceſſarily a right angle; for the ſail moves in a circle to which the wind is perpendicular: therefore the beſt angle of the ſail and axle will be 54°.44 nearly.

Such is the theory of the reſiſtance and impulſe of the air. It is extremely ſimple and of eaſy application. In all phyſical theories there are aſſumptions which depend on other principles, and thoſe on the judgment of the naturaliſt; ſo that it is always proper to confront the theory with experiment. There are even circumſtances in the preſent caſe which have not been attended to in the theory. When a ſtream of air is obſtructed by a ſolid body, or when a ſolid body moves along in air, the air is condenſed before it and rarefied behind. There is therefore a preſſure on the anterior parts ariſing from this want of equilibrium in the elaſticity of the air. This muſt be ſuperadded to the force ariſing from the impetus or inertia of the air. We cannot tell with preciſion what may be the amount of this condenſation; it depends on the velocity with which any condenſation diffuſes itſelf.

Alſo, if the motion be ſo rapid that the preſſure of the atmoſphere cannot make the air immediately occupy the place quitted by the body, it will ſuſtain this preſſure on its forepart to be added to the other forces.

317 Account of the principal experiments on this ſubject.

Experiments on this ſubject are by no means numerous; at leaſt ſuch experiments as can be depended on for the foundation of any practical application. The firſt that have this character are thoſe publiſhed by Mr Robins in 1742 in his treatiſe on Gunnery. They were repeated with ſome additions by the Chevalier Borda, and ſome account of them publiſhed in the Memoirs of the Academy of Sciences in 1763. In the Philoſophical tranſactions of the Royal Society of London, Vol. LXXIII. there are ſome experiments of the ſame kind on a larger ſcale by Mr Edgeworth. Theſe were all made in the way deſcribed in our account of Mr Robins's improvements in gunnery. Bodies were made to move with determined velocities, and the reſiſtances were meaſured by weights.

In all theſe experiments the reſiſtances were found very exactly in the proportion of the ſquares of the velocities; but they were found conſiderably greater than the weight of the column of air, whoſe height would produce the velocity in a falling body. Mr Robins's experiments on a ſquare of 16 inches, deſcribing 25,2 feet per ſecond, indicate the reſiſtance to be to this weight nearly as 4 to 3. Borda's experiments on the ſame ſurface ſtate the diſproportion ſtill greater.

The reſiſtances are found not to be in the proportion of the ſurfaces, but increaſe conſiderably faſter. Surfaces of 9, 16, 36, and 81 inches moving with one velocity, had reſiſtances in the proportion of 9, 17½, 42¼, and 104¾.

Now as this deviation from the proportion of the ſurfaces increaſes with great regularity, it is moſt probable that it continues to increaſe in ſurfaces of ſtill greater extent; and theſe are the moſt generally to be met with in practice in the action of wind on ſhips and mills.

Borda's experiments on 81 inches ſhow that the impulſe of wind moving one foot per ſecond is about $\frac{1}{500}$ of a pound on a ſquare foot. Therefore to find the impulſe on a foot correſponding to any velocity, divide the ſquare of the velocity by 500, and we obtain the impulſe in pounds. Mr Rouſe of Leiceſterſhire made many experiments, which are mentioned with great approbation by Mr Smeaton. His great ſagacity and experience in the erection of windmills oblige us to pay a conſiderable deference to his judgment. Theſe experiments confirm our opinion, that the impulſes increaſe faſter than the ſurfaces. The following table was calculated from Mr Rouſe's obſervations, and may be conſidered as pretty near the truth.

Velocity in feet.	Impulſe on a Foot in pounds,
0	0,000
10	0,129
20	0,915
30	2,059
40	3,660
50	5,718
60	8,234
70	11,207
80	14,638
90	18,526
100	22,872
110	27,675
120	32,926
130	38,654
140	44,830
150	51,462

If we multiply the ſquare of the velocity in feet by 16, the product will be the impulſe or reſiſtance on a ſquare foot in grains, according to Mr Rouſe's numbers.

The greateſt deviation from the theory occurs in the oblique impulſes. Mr Robins compared the reſiſtance of a wedge, whoſe angle was 90°, with the reſiſtance of its baſe; and inſtead of finding it leſs in the proportion of $\sqrt{2}$ to 1, as determined by the theory, he found it greater in the proportion of 55 to 68 nearly; and when he formed the body into a pyramid, of which the ſides had the ſame ſurface and the ſame inclination as the ſides of the wedge, the reſiſtance of the baſe and face were now as 55 to 39 nearly: ſo that here the ſame ſurface with the ſame inclination had its reſiſtance reduced from 68 to 39 by being put into this form. Similar deviations occur in the experiments of the Chevalier Borda; and it may be collected from both, that the reſiſtances diminiſh more nearly in the proportion of the ſines of incidence than in the proportion of the ſquares of thoſe ſines.

The irregularity in the reſiſtance of curved ſurfaces is as great as in plane ſurfaces. In general, the theory gives the oblique impulſes on plane ſurfaces much too ſmall, and the impulſes on curved ſurfaces too great. The reſiſtance of a ſphere does not exceed the fourth part of the reſiſtance of its great circle, inſtead of being its half; but the anomaly is ſuch as to leave hardly any room for calculation. It would be very deſirable to have the experiments on this ſubject repeated in a greater variety of caſes, and on larger ſurfaces, ſo that the errors of the experiments may be of leſs conſequence. Till this matter be reduced to ſome rule, the art of working ſhips muſt remain very imperfect, as muſt alſo the conſtruction of windmills.

The caſe in which we are moſt intereſted in the know-

318 It is of great conſequence to know the reſiſtance of air in the motion of bullets, &c.

knowledge of the reſiſtance of the air is the motion of bullets and ſhells. Writers on artillery have long been ſenſible of the great effect of the air's reſiſtance. It ſeems to have been this conſideration that chiefly engaged Sir Iſaac Newton to conſider the motions of bodies in a reſiſting medium. A propoſition or two would have ſufficed for ſhowing the incompatibility of the planetary motions with the ſuppoſition that the celeſtial ſpaces were filled with a fluid matter; but he has with great ſolicitude conſidered the motion of a body projected on the ſurface of the earth, and its deviation from the parabolic track aſſigned by Galileo. He has beſtowed more pains on this problem than any other in his whole work; and his inveſtigation has pointed out almoſt all the improvements which have been made in the application of mathematical knowledge to the ſtudy of nature. Nowhere does his ſagacity and fertility of reſource appear in ſo ſtrong a light as in the ſecond book of the *Principia*, which is almoſt wholly occupied by this problem. The celebrated mathematician John Bernouilli engaged in it as the fineſt opportunity of diſplaying his ſuperiority. A miſtake committed by Newton in his attempt to a ſolution was matter of triumph to him; and the whole of his performance, though a piece of elegant and elaborate geometry, is greatly hurt by his continually bringing this miſtake (which is a mere trifle) into view. The difficulty of the ſubject is ſo great, that ſubſequent mathematicians ſeem to have kept aloof from it; and it has been entirely overlooked by the many voluminous writers who have treated profeſſedly on military projectiles. They have ſpoken indeed of the reſiſtance of the air as affecting the flight of ſhot, but have ſaved themſelves from the taſk of inveſtigating this effect (a taſk to which they were unequal), by ſuppoſing that it was not ſo great as to render their theories and practical deductions very erroneous. Mr Robins was the firſt who ſeriouſly examined the ſubject. He ſhowed that even the Newtonian theory (which had been corrected, but not in the ſmalleſt degree improved or extended in its principles) was ſufficient to ſhow that the path of a cannon ball could not reſemble a parabola. Even this theory ſhowed that the reſiſtance was more that eight times the weight of the ball, and ſhould produce a greater deviation from the parabola than the parabola deviated from a ſtraght line.

319 The ignorance of the writers on artillery in this reſpect.

This ſimple but ſingular obſervation was a ſtrong proof how faulty the profeſſed writers on artillery had been, in rather amuſing themſelves with elegant but uſeleſs applications of eaſy geometry, than in endeavouring to give their readers any uſeful information. He added, that the difference between the ranges by the Newtonian theory and by experiment were ſo great, that the reſiſtance of the air muſt be vaſtly ſuperior to what that theory ſuppoſed. It was this which ſuggeſted to him the neceſſity of experiments to aſcertain this point. We have ſeen the reſult of theſe experiments in moderate velocities; and that they were ſufficient for calling the whole theory in queſtion, or at leaſt for rendering it uſeleſs. It became neceſſary therefore to ſettle every point by means of a direct experiment. Here was a great difficulty. How ſhall we meaſure either theſe great velocities which are obſerved in the motions of cannon ſhot, or the reſiſtance which theſe enormous velocities occaſion? Mr Robins had the ingenuity to do both. The method which he took for meaſuring the velocity of a muſket-ball was quite original; and it was ſuſceptible of great accuracy. We have already given an account of it under the article GUNNERY. Having gained this point, the other was not difficult. In the moderate velocities he had determined the reſiſtances by the forces which balanced them, the weights which kept the reſiſted body in a ſtate of uniform motion. In the great velocities, he propoſed to determine the reſiſtances by their immediate effects, by the retardations which they occaſioned. This was to be done by firſt aſcertaining the velocity of the ball, and then meaſuring its velocity after it had paſſed thro' a certain quantity of air. The difference of theſe velocities is the retardation, and the proper meaſure of the reſiſtance; for, by the initial and final velocities of the ball, we learn the time which was employed in paſſing through this air with the medium velocity. In this time the air's reſiſtance diminiſhed the velocity by a certain quantity. Compare this with the velocity which a body projected directly upwards would loſe in the ſame time by the reſiſtance of gravity. The two forces muſt be in the proportion of their effects. Thus we learn the proportion of the reſiſtance of the air to the weight of the ball. It is indeed true, that the time of paſſing through this ſpace is not accurately had by taking the arithmetical medium of the initial and final velocities, nor does the reſiſtance deduced from this calculation accurately correſpond to this mean velocity; but both may be accurately found by the experiment by a very troubleſome computation, as is ſhown in the 5th and 6th propoſitions of the ſecond book of Newton's *Principia*. The difference between the quantities thus found and thoſe deduced from the ſimple proceſs is quite trifling, and far within the limits of accuracy attainable in experiments of this kind; it may therefore be ſafely neglected.

320 Mr Robins made many experiments on this ſubject.

Mr Robins made many experiments on this ſubject; but unfortunately he has publiſhed only a very few, ſuch as were ſufficient for aſcertaining the point he had in view. He intended a regular work on the ſubject, in which the gradual variations of reſiſtance correſponding to different velocities ſhould all be determined by experiment: but he was then newly engaged in an important and laborious employment, as chief engineer to the Eaſt India Company, in whoſe ſervice he went out to India, where he died in leſs than two years. It is to be regretted, that no perſon has proſecuted theſe experiments. It would be neither laborious nor difficult, and would add more to the improvement of artillery than any thing that has been done ſince Mr Robins's death, if we except the proſecution of his experiments on the initial velocities of cannon ſhot by Dr Charles Hutton royal profeſſor at the Woolwich Academy. It is to be hoped that this gentleman, after having with ſuch effect and ſucceſs extended Mr Robins's experiments on the initial velocities of muſket-ſhot to cannon, will take up this other ſubject, and thus give the art of artillery all the ſcientific foundation which it can receive in the preſent ſtate of our mathematical knowledge. Till then we muſt content ourſelves with the practical rules which Robins has deduced from his own experiments. As he has not given us the mode of deduction, we muſt compare the reſults with experiment. He has indeed given a very extenſive compariſon with the numerous experiments made both in Britain and on the continent; and the agreement is very great. His learned commentator Euler has been at no pains to inveſtigate theſe rules, and has employed himſelf chiefly in detecting errors, moſt of which are ſuppoſed, becauſe he takes for a finiſhed work what Mr Robins only gives to the public as a haſty but uſeful ſketch of a new and very difficult branch of ſcience.

321 General reſult of them, &c.

The general reſult of Robins's experiments on the retardation of muſket-ſhot is, that although in moderate velocities the reſiſtance is ſo nearly in the duplicate proportion of the velocities that we cannot obſerve any deviation, yet in velocities exceeding 200 feet per ſecond the retardations increaſe faſter, and the deviation from this rate increaſes rapidly with the velocity. He aſcribes this to the cauſes already mentioned, viz. the condenſation of the air before the ball and to the rarefaction behind, in conſequence of the air not immediately occupying the ſpace left by the bullet. This increaſe is ſo great, that if the reſiſtance to a ball moving with the velocity of 1700 feet in a ſecond to be computed on the ſuppoſition that the reſiſtance obſerved in moderate velocities is increaſed in the duplicate ratio of the velocity, it will be found hardly one-third part of its real quantity. He found, for inſtance, that a ball moving thro' 1670 feet in a ſecond loſt about 125 feet per ſecond of its velocity in paſſing through 50 feet of air. This it muſt have done in the $\frac{1}{32}$ of a ſecond, in which time it would have loſt one foot if projected directly upwards; from which it appears that the reſiſtance was about 125 times its weight, and more than three times greater than if it had increaſed from the reſiſtance in ſmall velocities in the duplicate ratio of the velocities. He relates other experiments which ſhow ſimilar reſults.

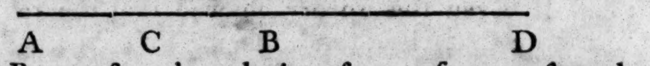
322 Partly controverted by Euler, but without ſufficient grounds.

But he alſo mentions a ſingular circumſtance, that till the velocities exceed 1100 feet per ſecond, the reſiſtances increaſe pretty regularly, in a ratio exceeding the duplicate ratio of the velocities; but that in greater velocities the reſiſtances become ſuddenly triple of what they would have been, even according to this law of increaſe. He thinks this explicable by the vacuum which is then left behind the ball, it being well known that air ruſhes into a vacuum with the velocity of 1132 feet per ſecond nearly. Mr Euler controverts this concluſion as inconſiſtent with that gradation which is obſerved in all the operations of nature; and ſays, that although the vacuum is not produced in ſmaller velocities than this, the air behind the ball muſt be ſo rare (the ſpace being but imperfectly filled), that the preſſure on the anterior part of the ball muſt gradually approximate to that preſſure which an abſolute vacuum would produce; but this is like his other criticiſms. Robins does nowhere aſſert that this ſudden change of reſiſtance happens in the tranſition of the velocity from 1132 feet to that of 1131 feet 11 inches or the like, but only that it is very ſudden and very great. It may be ſtrictly demonſtrated, that ſuch a change muſt happen in a narrow enough limit of velocities to juſtify the appellation of ſudden: a ſimilar fact may be obſerved in the motion of a ſolid through water. If it be gradually accelerated, the water will be found nearly to fill up its place, till the velocity arrives at a certain magnitude, correſponding to the immerſion of the body in the water; and then the ſmalleſt augmentation of its motion immediately produces a void behind it, into which the water ruſhes in a violent manner and is daſhed into froth. A gentleman, who has had many opportunities for ſuch obſervations, aſſures us, that when ſtanding near the line of direction of a cannon diſcharging a ball with a large allotment of powder, ſo that the initial velocity certainly exceeded 1100 feet per ſecond, he always obſerved a very ſudden diminution of the noiſe which the bullet made during its paſſage. Although the ball was coming towards him, and therefore its noiſe, if equable, would be continually increaſing, he obſerved that it was loudeſt at firſt. That this continued for a ſecond or two, and ſuddenly diminiſhed, changing to a ſound which was not only weaker, but differed in kind, and gradually increaſed as the bullet approached him. He ſaid, that the firſt noiſe was like the hiſſing of red-hot iron in water, and that the ſubſequent noiſe rather reſembled a hazy whiſtling. Such a change of ſound is a neceſſary conſequence of the different agitation of the air in the two caſes. We know alſo, that air ruſhing into a void, as when we break an exhauſted bottle, makes a report like a muſket.

Mr Robins's aſſertion therefore has every argument for its truth that the nature of the thing will admit. But we are not left to this vague reaſoning: his experiments ſhow us this diminution of reſiſtance. It clearly appears from them, that in a velocity of 1700 feet the reſiſtance is more than three times the reſiſtance determined by the theory which he ſuppoſes the common one. When the velocity was 1065 feet, the actual reſiſtance was $\frac{11}{7}$ of the theoretical; and when the velocity was 400 feet, the actual reſiſtance was about $\frac{4}{3}$ of the theoretical. That he aſſumed a theory of reſiſtance which gave them all too ſmall, is of no conſequence in the preſent argument.

323 Rule by Robins for computing reſiſtances and very rapid motions.

Mr Robins, in ſumming up the reſults of his obſervations on this ſubject, gives a rule very eaſily remembered for computing the reſiſtances to thoſe very rapid motions. It has been already mentioned in the article Gunnery, but we repeat it here, in order to accommodate it to the quantities which have been determined in ſome degree by experiment.



Let AB repreſent the velocity of 1700 feet per ſecond, and AC any other velocity. Make BD to AD as the reſiſtance given by the ordinary theory to the reſiſtance actually obſerved in the velocity 1700: then will CD be to AD as the reſiſtance aſſigned by the ordinary theory to the velocity AC is to that which really correſponds to it.

To accommodate this to experiment, recollect * that a ſphere of the ſize of a 12 pound iron ſhot, moving 25 feet in a ſecond, had a reſiſtance of $\frac{1}{22}$ of a pound. Augment this in the ratio of 25^2 to 1700^2, and we obtain 210 nearly for the theoretical reſiſtance to this velocity; but by comparing its diameter of $4\frac{1}{2}$ inches with $\frac{3}{4}$, the diameter of the leaden ball, which had a reſiſtance of at leaſt 11 pounds with this velocity, we conclude that the 12 pound ſhot would have had a reſiſtance of 396 pounds: therefore BD : AD = 210 : 396, and AB : AD = 186 : 396; and AB being 1700, AD will be 3613.

Let AD = a, AC = x, and let R be the reſiſtance to a 12 pound iron ſhot moving one foot per ſecond, and r the reſiſtance (in pounds) wanted for the velocity x; we

* See Gunnery, n° 19. &c.

we have $r=\mathrm{R}\frac{a x^2}{a-x}$. Mr Robins's experiments give $\mathrm{R}=\frac{1}{13750}$ very nearly. This gives $\mathrm{R}a=0,263235$, which is nearly one-fourth. Thus our formula becomes $r=\frac{0,263235\, x^2}{3613-x}$, or very nearly $\frac{x^2}{4(3612-x)}$, falling ſhort of the truth about $\frac{1}{20}$th part. The ſimplicity of the formula recommends it to our uſe, and when we increaſe its reſult $\frac{1}{20}$, it is incomparably nearer to the true reſult of the theory as corrected by Mr Robins than we can hope that the theory is to the actual reſiſtance. We can eaſily ſee that Mr Robins's correction is only a ſagacious approximation. If we ſuppoſe the velocity 3613 feet, a very poſſible thing, the reſiſtance by this formula is infinite, which cannot be. We may even ſuppoſe that the reſiſtance given by the formula is near the truth only in ſuch velocities as do not greatly exceed 1700 feet per ſecond. No military projectile exceeds 2200, and it is great folly to make it ſo great, becauſe it is reduced to 1700 almoſt in an inſtant, by the enormous reſiſtance.

The reſiſtance to other balls will be made by taking them in the duplicate ratio of the diameters.

324 The diſcuſſions of mathematicians not eaſily applied.

It has been already obſerved, that the firſt mathematicians of Europe have lately employed themſelves in improving this theory of the motion of bodies in a reſiſting medium; but their diſcuſſions are ſuch as few artilleriſts can underſtand. The problem can only be ſolved by approximation, and this by the quadrature of very complicated curves. They have not been able therefore to deduce from them any practical rules of eaſy application, and have been obliged to compute tables ſuited to different caſes. Of theſe performances, that of the Chevalier Borda, in the Memoirs of the Academy of Sciences in 1769, ſeems the beſt adapted to military readers, and the tables are undoubtedly of conſiderable uſe; but it is not too much to ſay, that the ſimple rules of Mr Robins are of as much ſervice, and are more eaſily remembered: beſides, it muſt be obſerved, that the nature of military ſervice does not give room for the application of any very preciſe rule. The only advantage that we can derive from a perfect theory would be an improvement in the conſtruction of pieces of ordnance, and a more judicious appropriation of certain velocities to certain purpoſes. The ſervice of a gun or mortar muſt always be regulated by the eye.

325 Borda's and Robins's apparently the beſt.

326 Undulation of air,

There is another motion of which air and other elaſtic fluids are ſuſceptible, viz, an internal vibration of their particles, or undulation, by which any extended portion of air is diſtributed into alternate parcels of condenſed and rarefied air, which are continually changing their condition without changing their places. By this change the condenſation which is produced in one part of the air is gradually transferred along the maſs of air to the greateſt diſtances in all directions. It is of importance to have ſome diſtinct conception of this motion. It is found to be by this means that diſtant bodies produce in us the ſenſation of ſound. See Sound, Acoustics. Sir Iſaac Newton treated this ſubject with his accuſtomed ingenuity, and has given us a theory of it in the end of the ſecond book of his *Principia*. This theory has been objected to with reſpect to the conduct of the argument, and other explanations have been given by the moſt eminent mathematicians. Though they appear to differ from Newton's, their reſults are preciſely the ſame; but, on a cloſe examination, they differ no more than John Bernouilli's theorem of centripetal forces differs from Newton's, viz. the one being expreſſed by geometry and the other by literal analyſis. The celebrated De la Grange reduces Newton's inveſtigation to a tautological propoſition or identical equation, but Mr Young of Trinity College, Dublin, has, by a different turn of expreſſion, freed Newton's method from this objection. We ſhall not repeat it here, but refer our mathematical readers to the article Acoustics, it not being our buſineſs at preſent to conſider its connection with ſound. This will make the ſubject of a diſtinct article.

327 Has been uſed to explain a variety of natural phenomena.

But ſince Newton publiſhed this theory of aerial undulations, and of their propagation along the air, and ſince the theory has been ſo corrected and improved as to be received by the moſt accurate philoſophers as a branch of natural philoſophy ſuſceptible of rigid demonſtration, it has been freely reſorted to by many writers on other parts of natural ſcience, who did not profeſs to be mathematicians, but made uſe of it for explaining phenomena in their own line on the authority of the mathematicians themſelves. Learning from them that this vibration, and the *quaquaverſum* propagation of the pulſes, were the neceſſary properties of an elaſtic fluid, and that the rapidity of this propagation had a certain aſſignable proportion to the elaſticity and denſity of the fluid, they freely made uſe of theſe conceſſions, and have introduced elaſtic vibrating fluids into many facts, where others would ſuſpect no ſuch thing, and have attempted to explain by their means many abſtruſe phenomena of nature. Æthers are every where introduced, endued with great elaſticity and tenuity. Vibrations and pulſes are ſuppoſed in this æther, and theſe are offered as explanations. The doctrines of animal ſpirits and nervous fluids, and the whole mechanical ſyſtem of Hartley, by which the operations of the ſoul are ſaid to be explained, have their foundation in this theory of aerial undulations. If theſe fancied fluids, and their internal vibrations, really operate in the phenomena aſcribed to them, any explanation that can be given of the phenomena from this principle muſt be nothing elſe than ſhowing that the legitimate conſequences of theſe undulations are ſimilar to the phenomena; or, if we are no more able to ſee the laſt ſtep than in the caſe of ſound (which we know to be *one* conſequence of the aerial undulations, although we cannot tell how), we muſt be able to point out, as in the caſe of ſound, certain conſtant relations between the general laws of theſe undulations and the general laws of the phenomena. It is only in this way that we think ourſelves intitled to ſay that the aerial undulations are cauſes, though not the only cauſes, of ſound; and it is becauſe there is no ſuch relation, but, on the contrary, a total diſſimilarity, to be obſerved between the laws of elaſtic undulations and the laws of the propagation of light, that we aſſert with confidence that ethereal undulations are not the cauſes of viſion.

328 But the application not being made with ſufficient preciſion,

Explanations of this kind ſuppoſe, therefore, in the firſt place, that the philoſopher who propoſes them underſtands preciſely the nature of theſe undulations; in the next place, that he makes his reader ſenſible of thoſe circumſtances of them which are concerned in the effect to be explained; and, in the third place, that he makes the reader underſtand how this circumſtance of the vibrating fluid is connected with the phenomenon, either by ſhowing it to be its mechanical cauſe, as when the philoſopher explains the reſounding of a muſical chord to a flute or pipe which gave the ſame tone; or by ſhowing that this circumſtance of the undulation always accompanies the phenomenon, as when the philoſopher ſhows that 233 vibrations of air in a ſecond, in whatever manner or by whatever cauſe they are produced, always are followed by the ſenſation of the tone C in the middle of the harpſichord.

But here we muſt obſerve, that, with the exception of Euler's unſucceſsful attempt to explain the optical phenomena by the undulations of ether, we have met with no explanation of natural phenomena, by means of elaſtic and vibrating fluids, where the author has ſo much as attempted any one of theſe three things, ſo indiſpenſably requiſite in a logical explanation. They have talked of vibrations without deſcribing them, or giving the reader the leaſt notion of what kind they are; and in no inſtance that we can recollect have they ſhowed how ſuch vibrations could have any influence in the phenomenon. Indeed, by not deſcribing with preciſion the undulations, they were freed from the taſk of ſhowing them to be mechanical cauſes of the phenomenon; and when any of them ſhow any analogy between the general laws of elaſtic undulations and the general laws of the phenomenon, the analogy is ſo vague, indiſtinct, or partial, that no perſon of common prudence would receive it as argument in any caſe in which he was much intereſted.

329 Has become the foundation of materialiſm.

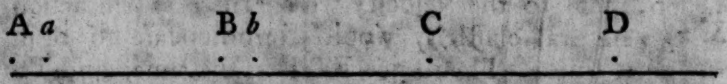
We think it our duty to remonſtrate againſt this ſlovenly way of writing: we would even hold it up to reprobation. It has been chiefly on this faithleſs foundation that the blind vanity of men has raiſed that degrading ſyſtem of opinions called MATERIALISM, by which the affections and faculties of the ſoul of man have been reſolved into vibrations and pulſes of ether.

330 Of the motion of elaſtic fluids.

We alſo think it our duty to give ſome account of this motion of elaſtic fluids. It muſt be ſuch an account as ſhall be underſtood by thoſe who are not mathematicians, becauſe thoſe only are in danger of being miſled by the improper application of them. Mathematical diſcuſſion is, however, unavoidable in a ſubject purely mathematical; but we ſhall introduce nothing that may not be eaſily underſtood or confided in; and we truſt that mathematical readers will excuſe us for a mode of reaſoning which appears lax and inelegant.

331 How they differ from unelaſtic fluids in propagating any agitation of their parts.

The firſt thing incumbent on us is to ſhow how elaſtic fluids differ from the unelaſtic in the propagation of any agitation of their parts. When a long tube is filled with water, and any one part of it puſhed out of its place, the whole is inſtantly moved like a ſolid maſs. But this is not the caſe with air. If a door be ſuddenly ſhut, the window at the farther end of a long and cloſe room will rattle; but ſome time will elapſe between the ſhutting of the door and the motion of the window. If ſome light duſt be lying on a braced drum, and another be violently beat at a little diſtance from it, an attentive obſerver will ſee the duſt dance up from the parchment; but this will be at the inſtant he hears the ſound of the ſtroke on the other drum, and a ſenſible time after the ſtroke. Many ſuch familiar facts ſhow that the agitation is gradually communicated along the air; and therefore that when one particle is agitated by any ſenſible motion, a finite time, however ſmall, muſt elapſe before the adjoining particle is agitated, in the ſame manner. This would not be the caſe in water if water be perfectly incompreſſible. We think that this may be made intelligible with very little trouble.



Let A, B, C, D, &c. be a row of aerial particles, at ſuch diſtances that their elaſticity juſt balances the preſſure of the atmoſphere; and let us ſuppoſe (as is deducible from the obſerved denſity of air being proportional to the compreſſing force) that the elaſticity of the particles, by which they keep each other at a diſtance, is as their diſtances inverſely. Let us farther ſuppoſe that the particle A has been carried, with an uniform motion, to *a* by ſome external force. It is evident that B cannot remain in its preſent ſtate; for being now nearer to *a* than to C, it is propelled towards C by the exceſs of the elaſticity of A above the natural elaſticity of C. Let E be the natural elaſticity of the particles, or the force correſponding to the diſtance BC or BA, and let F be the force which impels B towards C, and let *f* be the force exerted by A when at *a*. We have

$$E : f = \mathrm{B}a : \mathrm{BC}, = \mathrm{B}a : \mathrm{BA};$$
$$\text{and } E : f - E = \mathrm{B}a : \mathrm{BA} - \mathrm{B}a = \mathrm{B}a : \mathrm{A}a;$$
$$\text{or } E : F = \mathrm{B}a : \mathrm{A}a.$$

Plate CCCCV.

Now in fig. 71. let ABC be the line joining three particles, to which draw FG, PH parallel, and IAF, HBG perpendicular. Take IF or HG to repreſent the elaſticity correſponding to the diſtance AB. Let the particle A be ſuppoſed to have been carried with an uniform motion to *a* by ſome external force, and draw R*a*M perpendicular to RG, and make FI : RM = B*a* : BA. We ſhall then have FI : PM = B*a* : A*a*; and PM will repreſent the force with which the particle B is urged towards C. Suppoſe this conſtruction to be made for every point of the line AB, and that a point M is thus determined for each of them, mathematicians know that all theſe points M lie in the curve of a hyperbola, of which FG and GH are the aſymptotes. It is alſo known by the elements of mechanics, that ſince the motion of A along AB is uniform, A *a* or IP may be taken to repreſent the time of deſcribing A *a*; and that the area IPM repreſents the whole velocity which B has acquired in its motion towards C when A has come to *a*, the force urging B being always as the portion PM of the ordinate.

Take GX of any length in HG produced, and let GX repreſent the velocity which the uniform action of the natural elaſticity IF could communicate to the particle B during the time that A would uniformly deſcribe AB. Make GX to GY as the rectangle IFGH to the hyperbolic ſpace IFRM, and draw YS cutting MR produced in S, and draw FX cutting MR in T. It is known to the mathematicians that the point S is in a curve line FS*s* called the *logarithmic curve;* of which the leading property is, that any line RS parallel to GX is to GX as the rectangle IFGH is to the Hyperbolic ſpace IFRM, and that FX touches the curve in F.

This being the caſe, it is plain, that becauſe RT increaſes in the ſame proportion with FR, or with the rectangle IFRP, and RS increaſes in the proportion of the ſpace IFRM, TS increaſes in the proportion of the ſpace IPM. Therefore TS is proportional to the velocity of B when A has reached *a*, and RT is pro-

PNEUMATICS. Plate CCCCV.

Fig. 57.

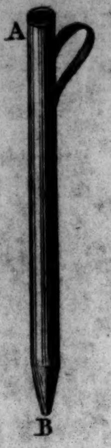


Fig. 58.

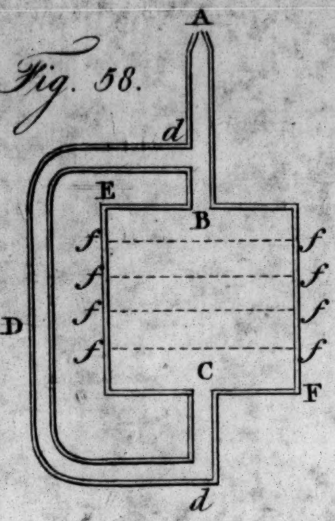


Fig. 61.

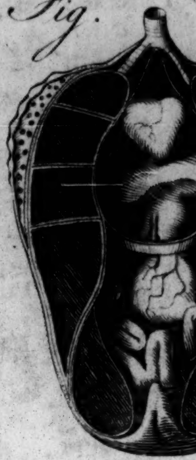


Fig. 62.

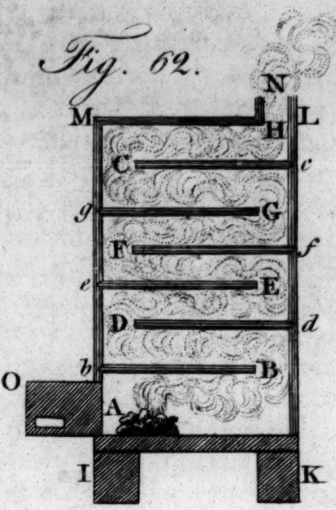

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Fig. 59.

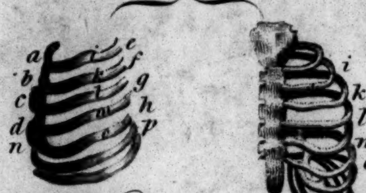
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Fig. 60.

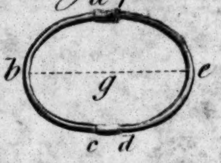

Fig. 63.

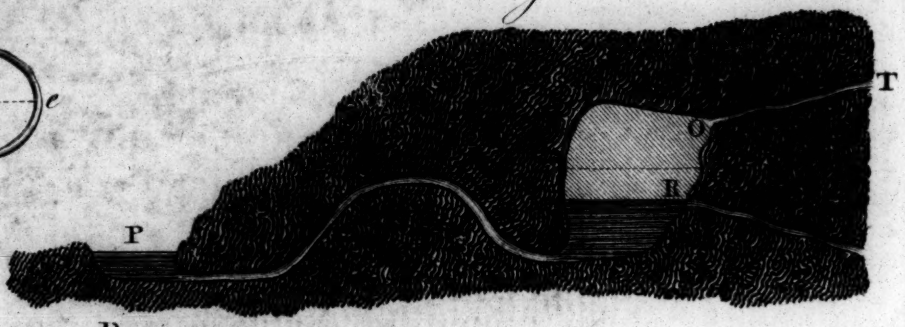

Fig. 64.

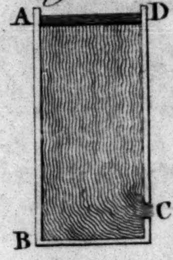

Fig. 65.

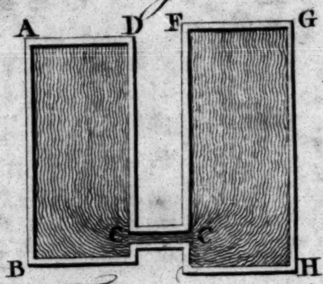

Fig. A.

Fig. 66.

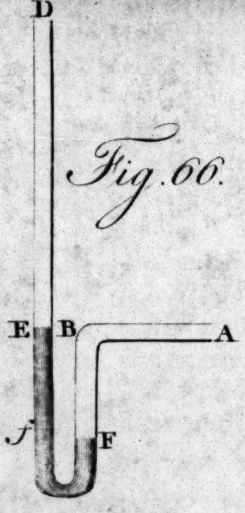

Fig. 67.

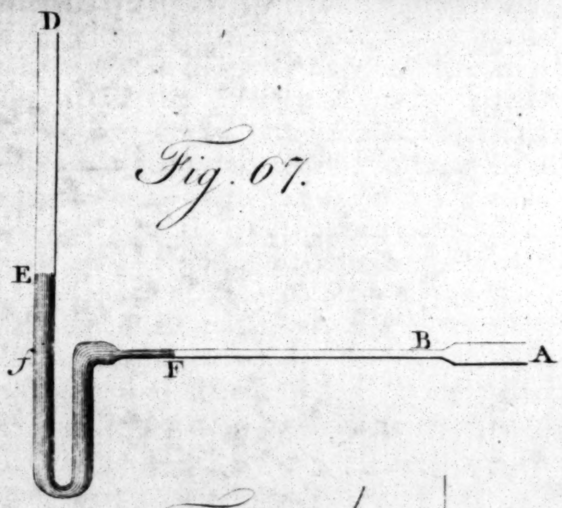

Fig. 70.

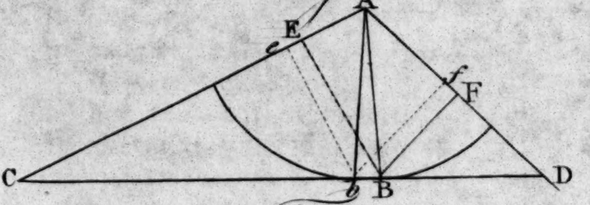

Fig. 68.

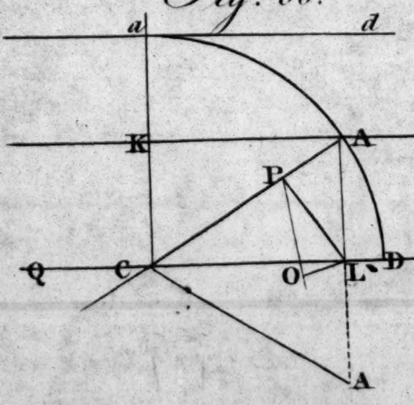
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Fig. 69.

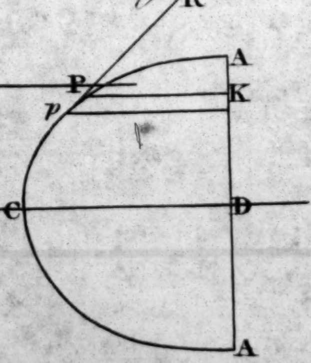
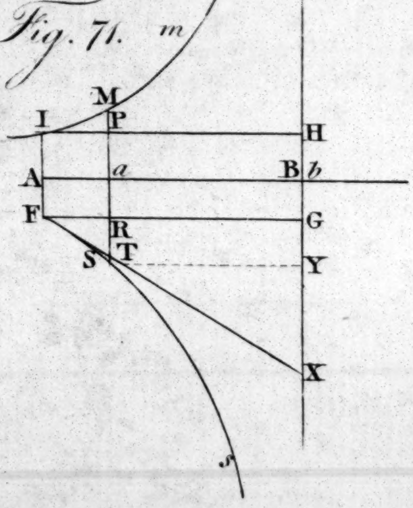


Fig. 71.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proportional to the velocity which the uniform action of the natural elaſticity would communicate to B in the ſame time. Then ſince FT is as the time, and TS is as the velocity, the area FTS will be as the ſpace deſcribed by B (urged by the variable force PM); while A, urged by the external force, deſcribes A *a*; and the triangle FRT will repreſent the ſpace which the uniform action of the natural elaſticity would cauſe B to deſcribe in the ſame time.

And thus it is plain that theſe three motions can be compared together: the uniform motion of the agitated particle A, the uniformly accelerated motion which the natural elaſticity would communicate to B by its conſtant action, and the motion produced in B by the agitation of A. But this compariſon, requiring the quadrature of the hyperbola and logarithmic curve, would lead us into moſt intricate and tedious computations. Of theſe we need only give the reſult, and make ſome other compariſons which are palpable.

Let A*a* be ſuppoſed indefinitely ſmall in compariſon of AB. The ſpace deſcribed by A is therefore indefinitely ſmall; but in this caſe we know that the ratio of the ſpace FRT to the rectangle IFRP is indefinitely ſmall. There is therefore no compariſon between the agitation of A by the external force, and the agitation which natural elaſticity would produce on a ſingle particle in the ſame time, the laſt being incomparably ſmaller than the firſt. And this ſpace FRT is incomparably greater than FTS; and therefore the ſpace which B would deſcribe by the uniform action of the natural elaſticity is incomparably greater than what it would deſcribe in conſequence of the agitation of A.

From this reaſoning we ſee evidently that A muſt be ſenſibly moved, or a finite or meaſurable time muſt elapſe before B acquires a meaſurable motion. In like manner B muſt move during a meaſurable time before C acquires a meaſurable motion, &c.; and therefore the agitation of A is communicated to the diſtant particles in gradual ſucceſſion.

By a farther compariſon of theſe ſpaces we learn the time in which each ſucceeding particle acquires the very agitation of A. If the particles B and C only are conſidered, and the motion of C neglected, it will be found that B has acquired the motion of A a little before it has deſcribed $\frac{1}{3}$ of the ſpace deſcribed by A; but if the motion of C be conſidered, the acceleration of B muſt be increaſed by the retreat of C, and B muſt deſcribe a greater ſpace in proportion to that deſcribed by A. By computation it appears, that when both B and C have acquired the velocity of A, B has deſcribed nearly $\frac{1}{2}$ of A's motion, and C more nearly $\frac{1}{3}$. Extending this to D, we ſhall find that D has deſcribed ſtill more nearly $\frac{1}{2}$ of A's motion. And from the nature of the computation it appears that this approximation goes on rapidly: therefore, ſuppoſing it accurate from the very firſt particle, it follows from the equable motion of A, that each ſucceeding particle moves through an equal ſpace in acquiring the motion of A.

The concluſion which we muſt draw from all this is, that when the agitation of A has been fully communicated to a particle at a *ſenſible* diſtance, the intervening particles, all moving forward with a common velocity, are equally compreſſed as to ſenſe, except a very few of the firſt particles; and that this communication, or this propagation of the original agitation, goes on with an uniform velocity.

Theſe computations need not be attended to by ſuch as do not wiſh for an accurate knowledge of the preciſe agitation of each particle. It is enough for ſuch readers to ſee clearly that time *muſt* eſcape between the agitation of A and that of a diſtant particle; and this is abundantly manifeſt from the incomparability (excuſe the term) of the naſcent rectangle IFRP with the naſcent triangle FRT, and the incomparability of FRT with FTS.

What has now been ſhown of the communication of any ſenſible motion A *a* muſt hold equally with reſpect to any change of this motion. Therefore, if a tremulous motion of a body, ſuch as a ſpring or bell, ſhould agitate the adjoining particle A by puſhing it forward in the direction AB, and then allowing it to come back again in the direction BA, an agitation ſimilar to this will take place in all the particles of the row one after the other. Now if this body vibrate according to the law of motion of a pendulum vibrating in a cycloid, the neighbouring particle of air *will of neceſſity* vibrate in the ſame manner; and then Newton's demonſtration in art ACOUSTICS needs no apology. Its only deficiency was, that it *ſeemed* to prove that this *would be* the way in which every particle would of neceſſity vibrate; which is not true, for the ſucceſſive parcels of air will be differently agitated according to the original agitation. Newton only wants to prove the uniform propagation of the agitations, and he ſelects that form which renders the proof eaſieſt. He proves, in the moſt unexceptionable manner, that if the particles of a pulſe of air are really moving like a cycloidal pendulum, the forces acting on each particle, in conſequence of the compreſſion and dilatation of the different parts of the pulſe, are preciſely ſuch as are neceſſary for continuing this motion, and therefore no other forces are required. Then ſince each particle is in a certain part of its path, is moving in a certain direction, and with a certain velocity, and urged by a determined force, it *muſt* move in that very manner. The objection ſtarted by John Bernouilli againſt Newton's demonſtration (in a ſingle line) of the elliptical motion of a body urged by a force in the inverſe duplicate ratio of the diſtance from the focus, is preciſely the ſame with the objection againſt Newton's demonſtration of the progreſs of aerial undulations, and is equally futile.

332
Newton's demonſtration on this ſubject juſt as far as it goes;

It muſt, however, be obſerved, that Newton's demonſtration proceeds on the ſuppoſition that the linear agitations of a particle are incomparably ſmaller than the extent of an undulation. This is not ſtrictly the caſe in any inſtance, and in many it is far from being true. In a pretty ſtrong twang of a harpſichord wire, the agitation of a particle may be near the 50th part of the extent of the undulation. This muſt diſturb the regularity of the motion, and cauſe the agitations in the remote undulations to differ from thoſe in the firſt pulſe. In the exploſion of a cannon, the breaking of an exhauſted bottle, and many inſtances which may be given, the agitations are ſtill greater. The commentators on Newton's *Principia*, Le Sueur and Jacquier, have ſhown, and Euler more clearly, that when the original agitations are very violent, the particles of air will acquire a ſubordinate vibration compounded with the regular cycloidal vibration, and the progreſs of the pulſes will be ſomewhat more rapid; but the intricacy of the calculus is ſo great, that they have not been able to determine with any tolerable preciſion what the change of velocity will be.

333 It is ſtrengthened by comparing the ſound of a cannon near and at a diſtance.

All this, however, is fully confirmed by experiment on ſounds. The ſound of a cannon at 10 or 20 miles diſtance does not in the leaſt reſemble its ſound when near. In this caſe it is a loud inſtantaneous crack, to which we can aſſign no muſical pitch: at a diſtance, it is a grave ſound, of which we can tell the note; and it begins ſoftly, ſwells to its greateſt loudneſs, and then dies away growling. The ſame may be ſaid of a clap of thunder, which we know to be a loud ſnap of ſtill leſs duration. It is highly probable that the appreciable tone which thoſe diſtant ſounds afford are produced by the continuance of theſe ſubordinate vibrations which are added together and fortified in the ſucceſſive pulſes, though not perceptible in the firſt, in a way ſomewhat reſembling the reſonance of a muſical chord. Newton's explanation gathers evidence therefore from this circumſtance. And we muſt further obſerve, that all elaſtic bodies tremble or vibrate almoſt preciſely as a pendulum ſwinging into a cycloid, unleſs their vibrations are uncommonly violent; in which caſe they are quickly reduced to a moderate quantity by the reſiſtance of the air. The only very loud ſounds which we can produce in this way are from great bells; and in theſe the utmoſt extent of the vibration is very ſmall in compariſon with the breadth of the pulſe. The velocity of theſe ſounds has not been compared with that of cannon, or perhaps it would be found leſs, and an objection againſt Newton's determination removed. He gives 969 feet per ſecond, Experiment 1142.

334 The agitation in all probability in the ſucceſſive pulſes aſſumes a cyclodial form.

But it is alſo very probable, that in the propagation through the air, the agitation gradually and rapidly approaches to this regular cycloidal form in the ſucceſſive pulſes, in the ſame way as we obſerve that whatever is the form of agitation in the middle of a ſmooth pond of water, the ſpreading circles are always of one gentle form without aſperities. In like manner, into whatever form we throw a ſtretched cord by the twang which we give it, it almoſt immediately makes ſmooth undulations, keeping itſelf in the ſhape of an elongated trochoid. Of this laſt we can demonſtrate the neceſſity, becauſe the caſe is ſimple. In the wave, the inveſtigation is next to impoſſible; but we ſee the fact. We may therefore preſume it in air. And accordingly we know that any noiſe, however abrupt and jarring, near at hand, is ſmooth at a diſtance. Nothing is more rough and harſh than the ſcream of a heron; but at half a mile's diſtance it is ſoft. The ruffle of a drum is alſo ſmooth at a diſtance.

Plate CCCCVI.

Fig. 72. ſhows the ſucceſſive ſituations of the particles of a row. Each line of the figure ſhows the ſame particles marked with the ſame letters; the firſt particle *a* being ſuppoſed to be removed ſucceſſively from its quieſcent ſituation and back to it again. The mark × is put on that part of each line where the agitated particles are at their natural diſtances, and the air is of the natural denſity. The mark 1 is put where the air is moſt of all compreſſed: and, where it is moſt of all dilated; the curve line drawn through the loweſt line of the figure is intended to repreſent the denſity in every point, by drawing ordinates to it from the ſtraight line: the ordinates below the line indicate a rarity, and thoſe above the line a denſity, greater than common.

It appears that when *a* has come back to its natural ſituation, the part of greateſt denſity is between the particles *i* and *k*, and the greateſt rarity between *c* and *d*.

We have only to add, that the velocity of this propagation depends on the elaſticity and denſity of the fluid. If theſe vary in the ſame proportion, that is, if the fluid has its elaſticity proportional to its denſity, the velocity will remain the ſame. If the elaſticity or denſity alone be changed, the velocity of the undulations will change in the direct ſubduplicate ratio of the elaſticity and the inverſe ſubduplicate ratio of the denſity; for ſhould the elaſticity be quadrupled, the quantity of motion produced by it in any given time will be quadrupled. This will be the caſe if the velocity be doubled; for there would then be double the number of particles doubly agitated. Should the denſity be quadrupled, the elaſticity remaining the ſame, the quantity of motion muſt remain the ſame. This will be the caſe if the velocity be reduced to one half; for this will propagate half the agitation to half the diſtance, which will communicate it to twice the number of particles, and the quantity of motion will remain the ſame. The ſame may be ſaid of other proportions, and therefore $V = \frac{\sqrt{E}}{\sqrt{D}}$. Therefore a change in the barometer will not affect the velocity of the undulations in air, but they will be accelerated by heat, which diminiſhes its denſity, or increaſes its elaſticity. The velocity of the pulſes in inflammable air muſt be at leaſt thrice as great, becauſe its denſity is but one-tenth of that of air when the elaſticity of both are the ſame.

335 Further conſideration of aerial pulſes as they really occur.

Let us now attend a little to the propagation of aerial pulſes as they really happen; for this hypotheſis of a ſingle row of particles is nowhere to be obſerved.

Suppoſe a ſphere A, fig. 73. filled with condenſed air, and that the veſſel which contains it is ſuddenly annihilated. The air muſt expand to its natural dimenſions, ſuppoſe BCD. But it cannot do this without preſſing aſide the ſurrounding air. We have ſeen that in any ſingle row of particles this cannot be at once diffuſed to a diſtance, but muſt produce a condenſation in the air adjoining; which will be gradually propagated to a diſtance. Therefore this ſphere BCD of the common denſity will form round it a ſhell, bounded by EFG, of condenſed air. Suppoſe that at this inſtant the inner air BCD becomes ſolid. The ſhell of condenſed air can expand only outwards. Let it expand till it is of the common denſity, occupying the ſhell HIK. This expanſion, in like manner, muſt produce a ſhell of condenſed air without it: at this inſtant let HIK become ſolid. The ſurrounding ſhell of condenſed air can expand only outward, condenſing another ſhell without it. It is plain that this muſt go on continually, and the central agitation will be gradually propagated to a diſtance in all directions. But, in this proceſs, it is not the ſame numerical particles that go to a diſtance. Thoſe of the original ſphere go no further than BCD, thoſe of the next ſhell go no further than HIK, &c. Farther, the expanſion outwards of any particle will be more moderate as the diffuſion advances; for the whole motion of each ſhell cannot exceed the original quantity of motion; and the number of particles in each ſucceſſive ſhell increaſes as the ſurface, that is, as the ſquare of the diſtance from the centre: therefore the agitation of the particles will decreaſe in the ſame ratio, or will be in the inverſe duplicate ratio of the diſtance from the centre. Each ſucceſſive ſhell, therefore, contains the ſame quantity of motion, and the ſucceſſive agitations of the particles of any row out from the centre will not be equal to the original agitation, as happens in the ſolitary row. But, this does not affect the velocity of the propagation, becauſe all agitations are propagated equally faſt.

We ſuppoſed the air A to become ſolid as ſoon as it acquired the common denſity; but this was to facilitate the conception of the diffuſion. It does not ſtop at this bulk; for while it was denſer it had a tendency to expand. Therefore each particle has attained this diſtance with an accelerated motion. It will, therefore, continue this motion like a pendulum that has paſſed the perpendicular, till it is brought to reſt by the air without it; and it is now rarer than common air, and collapſes again by the greater elaſticity of the air without it. This outward air, therefore, in regaining its natural denſity, muſt expand both ways. It expands towards the centre following the collapſing of the air within it; and it expands outwards, condenſing the air beyond it. By expanding inwards, it will again condenſe the air within it, and this will again expand; a ſimilar motion happens in all the outward ſhells; and thus there is propagated a ſucceſſion of condenſed and rarefied ſhells of air, which gradually ſwell to the greateſt diſtance.

336 Application of the fact of dropping a pebble into water.

It may be demonſtrated, that when the central air has for the ſecond time acquired the natural denſity, it will be at reſt, and be diſturbed no more; and that this will happen to all the ſhells in ſucceſſion. But the demonſtration is much too intricate for this place; we muſt be contented with pointing out a fact perfectly analogous. When we drop a ſmall pebble into water, we ſee it produce a ſeries of circular waves, which go along the ſurface of ſmooth water to a great diſtance, becoming more and more gentle as they recede from the centre; and the middle, where the agitation was firſt produced, remains perfectly ſmooth, and this ſmoothneſs extends continually; that is, each wave when brought to a level remains at reſt. Now theſe waves are produced and propagated by the depreſſion and elevation made at the centre. This elevation tends to diffuſe itſelf; and the force with which each particle of water is actuated is a force acting directly up and down, and is proportional to the elevation or depreſſion of the particle. This hydroſtatical preſſure operates preciſely in the ſame way as the condenſation and rarefaction of the air; and the mathematical inveſtigation of the propagation of the circular undulations on ſmooth water is ſimilar in every ſtep to that of the propagation of the ſpherical waves in ſtill air. For this we appeal to Newton's *Principia*, or to Euler's *Opuſcula*, where he gives a very beautiful inveſtigation of the velocity of the aerial pulſes; and to ſome memoirs of de la Grange in the collections of the academies of Berlin and Turin. Theſe two laſt authors have made the inveſtigation as ſimple as ſeems poſſible, and have freed it from every objection which can be ſtated againſt the geometrical one of their great teacher Newton.

337 The waves of water are uſeful for explaining thoſe of air,

Having ſaid this much on the ſimilarity between the waves on water and the aerial undulations, we ſhall have recourſe to them, as affording us a very ſenſible object to repreſent many affections of the other which it would be extremely difficult to explain. We neither ſee nor feel the aerial undulations; and they behoved, therefore, to be deſcribed very abſtractedly and imperfectly. In the watery wave there is no permanent progreſſive motion of the water from the centre. Throw a ſmall bit of cork on the ſurface, and it will be obſerved to popple up and down without the leaſt motion outwards. In like manner, the particles of air are only agitated a very little outwards and inwards; which motion is communicated to the particles beyond them, while they themſelves come to reſt, unleſs agitated afreſh; and this agitation of the particles is inconceivably ſmall. Even the exploſion of a cannon at no great diſtance will but gently agitate a feather, giving it a ſingle impulſe outwards, and immediately after another inwards or towards the cannon. When a harpſicord wire is forcibly twanged at a few feet diſtance, the agitation of the air is next to inſenſible. It is not, however, nothing; and it differs from that in a watery wave by being *really* outwards and inwards. In conſequence of this, when the condenſed ſhell reaches an elaſtic body, it impels it ſlightly. If its elaſticity be ſuch as to make it acquire the oppoſite ſhape at the inſtant that the next agitation and condenſed ſhell of air touches it, its agitation will be doubled, and a third agitation will increaſe it, and ſo on, till it acquire the agitation competent to that of the ſhell of air which reaches it, and it is thrown into *ſenſible* vibration, and gives a ſound extremely faint indeed, becauſe the agitation which it acquires is that correſponding to a ſhell of air conſiderably removed from the original ſtring. Hence it happens that a muſical chord, pipe, or bell, will cauſe another to reſound, whoſe vibrations are iſochronous with its own; or if the vibrations of the one coincides with every ſecond, or third or fourth, &c. of the other; juſt as we can put a very heavy pendulum into ſenſible motion by giving it a gentle puff with the breath at every vibration, or at every ſecond, third, or fourth, &c. A drum ſtruck in the neighbourhood of another drum will agitate it *very ſenſibly*; for here the ſtroke depreſſes a very conſiderable ſurface, and produces an agitation of a conſiderable maſs of air: it will even agitate the ſurface of ſtagnant water. The exploſion of a cannon will even break a neighbouring window. The ſhell of condenſed air which comes againſt the glaſs has a great ſurface and a great agitation: the beſt ſecurity in this caſe is to throw up the ſaſh; this admits the condenſed air into the room, which acts on the inſide of the window, balancing part of the external impulſe.

338 For waves of air and of water are in many reſpects very ſimilar.

It is demonſtrated in every elementary treatiſe of natural philoſophy, that when a wave on water meets any plane obſtacle, it is reflected from it by a centre equally removed behind the obſtacle; that waves radiating from the focus of a parabola are reflected in waves perpendicular to its axis; that waves radiating from one focus of an ellipſe are made to converge to the other focus, &c. &c. All this may be affirmed of the aerial undulations; that when part of a wave gets through a hole in the obſtacle, it becomes the centre of a new ſeries of waves; that waves bend round the extremities of an obſtacle: all this happens in the aerial undulations. And laſtly, that when the ſurface of water is thrown into regular undulations by one agitation, another agitation in another place will produce other regular waves, which will croſs the former without diſturbing them in the ſmalleſt degree. The ſame thing happens in air; and experiments may be made on water which will illuſtrate in the moſt perfect manner many other affections of the aerial pulſes, which we ſhould otherwiſe conceive very imperfectly. We would recommend to our curious readers to make ſome of theſe experiments in a large veſſel of milk. Take a long and narrow plate of lead, which, when ſet on the bottom of the veſſel will reach above the ſurface of the milk; bend this plate into a parabola, elliptical or other curve. Make the undulations by dropping milk on the focus from a ſmall pipe, which will cauſe the agitations to ſucceed with rapidity, and then all that we have ſaid will be moſt diſtinctly ſeen, and the experiment will be very amuſing and inſtructive, eſpecially to the muſical reader.

339 Caution to the ſupporters of æthers, animal ſpirits, &c.

We would now requeſt all who make or read explanations of natural phenomena by means of vibrations of ethers, animal ſpirits, nervous fluids, &c. to fix their attention on the nature of the agitation in one of theſe undulations. Let him conſider whether this can produce the phenomenon, acting as any matter muſt act, by impulſe or by preſſure. If he ſees that it can produce the phenomenon, he will be able to point out the very motion it will produce, both in quantity and direction, in the ſame manner as Sir Iſaac Newton has pointed out all the irregularities of the moon's motion produced by the diſturbing force of the ſun. If he cannot do this, he fails in giving the firſt evidence of a mechanical explanation by the action of an elaſtic vibrating fluid. Let him then try to point out ſome palpable connection between the general phenomena of elaſtic undulations and the phenomenon in queſtion; this would ſhow an accompaniment to have at laſt ſome probability. It is thus only we learn that the undulations of air produce ſound: we cannot tell how they affect the mechaniſm of the ear; but we ſee that the phenomena of ſound always accompany them, and that certain modifications of the one are regularly accompanied by certain modifications of the other. If we cannot do this neither, we have derived neither explanation nor illuſtration from the elaſtic fluid. And laſtly, let him remember that even if he ſhould be able to ſhow the competency of this fluid to the production of the phenomenon, the whole is ſtill an hypotheſis, becauſe we do not know that ſuch a fluid exiſts.

340 The folly of appealing to ſuch unknown ſubſtances.

We will venture to ſay, that whoever will proceed in this prudent manner will ſoon ſee the futility of moſt of the explanations of this kind which have been given. They are unfit for any but conſummate mathematicians: for they alone really underſtand the mechaniſm of aerial undulations, and even they ſpeak of them with heſitation as a thing but imperfectly underſtood. But even the unlearned in this ſcience can ſee the incompatibility of the hypotheſis with many things which they are brought to explain. To take an inſtance of the conveyance of ſenſation along the nerves; an elaſtic fluid is ſuppoſed to occupy them, and the undulations of this fluid are thought to be propagated along the nerves. Let us juſt think a little how the undulations would be conveyed along the ſurface of a canal which was completely filled up with reeds and bulruſhes, or let us make the experiment on ſuch a canal: we may reſt aſſured that the undulations in the one caſe will reſemble thoſe in the other; and we may ſee that in the canal there will be no regular or ſenſible propagation of the waves.

Let theſe obſervations have their influence, along with others which we have made on other occaſions, to wean our readers from this faſhionable proneneſs to introduce inviſible fluids and unknown vibrations into our phyſical diſcuſſions. They have done immenſe, and we fear irreparable, miſchief in ſcience; and there is but one phenomenon that has ever received any explanation by their means.

This may ſuffice for a looſe and popular account of aerial undulations; and with it we conclude our account of the motion, impulſe, and reſiſtance of air.

We ſhall now explain a number of natural appearances, depending on its preſſure and elaſticity, appearances not ſufficiently general, or too complicated for the purpoſes of argument, while we were employed in the inveſtigation of theſe properties, but too important to be paſſed over in ſilence.

341 The air's preſſure occaſions the coheſion of two ſurfaces accurately fitting each other.

It is owing to the preſſure of the atmoſphere that two ſurfaces which accurately fit each other cohere with ſuch force. This is a fact familiarly known to the glaſs-grinders, poliſhers of marble, &c. A large lens or ſpeculum, ground on its tool till it become very ſmooth, requires more than any man's ſtrength to ſeparate it directly from the tool. If the ſurface is only a ſquare inch, it will require 15 pounds to ſeparate them perpendicularly, though a very moderate force will make them ſlide along each other. But this coheſion is not obſerved unleſs the ſurfaces are wetted or ſmeared with oil or greaſe; otherwiſe the air gets between them, and they ſeparate without any trouble. That this coheſion is owing to the atmoſpheric preſſure, is evident from the eaſe with which the plates may be ſeparated in an exhauſted receiver.

342 And the adheſion of ſnails, &c. to rocks.

To the ſame cauſe we muſt aſcribe the very ſtrong adheſion of ſnails, periwinkles, limpets, and other univalve ſhells, to the rocks. The animal forms the rim of its ſhell ſo as to fit the ſhape of the rock to which it intends to cling. It then fills its ſhell (if not already filled by its own body) with water. In this condition it is evident that we muſt act with a force equal to 15 pounds for every ſquare inch of touching ſurface before we can detach it. This may be illuſtrated by filling a drinking glaſs to the brim with water; and having covered it with a piece of thin wet leather, whelm it on a table, and then try to pull it ſtraight up; it will require a conſiderable force. But if we expoſe a ſnail adhering to a ſtone in the exhauſted receiver, we ſhall ſee it drop off by its own weight. In the ſame manner do the remora, the polypus, the lamprey, and many other animals, adhere with ſuch firmneſs. Boys frequently amuſe themſelves by pulling out large ſtones from the pavement by means of a circle of ſtiff wetted leather faſtened to a ſtring. It is owing to the ſame cauſe that the bivalve ſhell fiſhes keep themſelves ſo firmly ſhut. We think the muſcular force of an oyſter prodigious, becauſe it requires ſuch force to open it; but if we grind off a bit of the convex ſhell, ſo as to make a hole in it, though without hurting the fiſh in the ſmalleſt degree, it opens with great eaſe, as it does alſo in *vacuo*.

353 Other effects of the air's preſſure.

The preſſure of the air, operating in this way contributes much to the coheſion of bodies, where we do not ſuſpect its influence. The tenacity of our mortars and cements would frequently be ineffectual without this aſſiſtance.

It is owing to the preſſure of the atmoſphere that a caſk will not run by the cock unleſs a hole be opened in ſome other part of the caſk. If the caſk is not quite full, ſome liquor indeed will run out, but it will ſtop as ſoon as the diminiſhed elaſticity of the air above the liquor is in equilibrio (together with the liquor) with the atmoſpheric preſſure. In like manner, a tea-pot muſt have a ſmall hole in its lid to enſure its pouring out the tea. If indeed the hole in the caſk is of large dimenſions, it will run without any other hole, becauſe air will get in at the upper ſide of the hole while the liquor runs out by the lower part of it.

Plate CCCCV.

On the ſame principle depends the performance of an inſtrument uſed by the ſpirit dealers for taking out a ſample of their ſpirits. It conſiſts of a long tinplate tube AB (fig. 57.), open a-top at A, and ending in a ſmall hole at B. The end B is dipped into the ſpirits, which riſes into the tube; then the thumb is clapt on the mouth A, and the whole is lifted out of the caſk. The ſpirit remains in it till the thumb be taken off; it is then allowed to run into a glaſs for examination.

344 Why froſts inſtantly occaſion a ſcarcity of water.

It ſeems principally owing to the preſſure of the air that froſts immediately occaſion a ſcantineſs of water in our fountains and wells. This is erroneouſly accounted for, by ſuppoſing that the water freezes in the bowels of the earth. But this is a great miſtake: the moſt intenſe froſt of a Siberian winter would not freeze the ground two feet deep; but a very moderate froſt will conſolidate the whole ſurface of a country, and make it impervious to the air; eſpecially if the froſt has been preceded by rain, which has ſoaked the ſurface. When this happens, the water which was filtering through the ground is all arreſted and kept ſuſpended in its capillary tubes by the preſſure of the air, in the very ſame manner as the ſpirits are kept ſuſpended in the inſtrument juſt now deſcribed by the thumb's ſhutting the hole A. A thaw melts the ſuperficial ice, and allows the water to run in the ſame manner as the ſpirits run when the thumb is removed.

345 The neceſſity of common air to animal life.

Common air is neceſſary for ſupporting the lives of moſt animals. If a ſmall animal, ſuch as a mouſe or bird, be put under the receiver of an air-pump, and the air be exhauſted, the animal will quickly be thrown into convulſions and fall down dead; if the air be immediately readmitted, the animal will ſometimes revive, eſpecially if the rarefaction has been briſkly made, and has not been very great. We do not know that any breathing animal can bear the air to be reduced to $\frac{1}{4}$ of its ordinary denſity, nor even $\frac{1}{3}$; nor have we good evidence that an animal will ever recover if the rarefaction is puſhed very far, although continued for a very ſhort time.

But the mere preſence of the air is by no means ſufficient for preſerving the life of the animal; for it is found, that an animal ſhut up in a veſſel of air cannot live in it for any length of time. If a man be ſhut up in a box, containing a wine hogſhead of air, he cannot live in it much above an hour, and long before this he will find his breathing very unſatisfactory and uneaſy. A gallon of air will ſupport him about a minute. A box EF (fig. 58.) may be made, having a pipe AB inſerted into its top, and fitted with a very light valve at B, opening upwards. This pipe ſends off a lateral, branch *a*D*d*C, which enters the box at the bottom, and is alſo fitted with a light valve at C opening upwards. If a perſon breathe through the pipe, keeping his noſtrils ſhut, it is evident that the air which he expires will not enter the box by the hole B, nor return through the pipe C*d*D; and by this contrivance he will gradually employ the whole air of the box. With this apparatus experiments can be made without any riſk or inconveniency, and the quantity of air neceſſary for a given time of eaſy breathing may be accurately aſcertained.

How the air of our atmoſphere produces this effect is a queſtion which does not belong to mechanical philoſophy to inveſtigate or determine. We can, however, affirm, that is neither the preſſure nor the elaſticity of the air which is immediately concerned in maintaining the animal functions. We know that we can live and breathe with perfect freedom on the tops of the higheſt mountains. The valley of Quito in Peru, and the country round Gondur in Abyſſinia, are ſo far elevated above the ſurface of the ocean, that the preſſure and the elaſticity of the air are one-third leſs than in the low countries; yet theſe are populous and healthy places. And, on the other hand, we know, that when an animal has breathed in any quantity of air for a certain time without renewal, it will not only be ſuffocated, but another animal put into this air will die immediately; and we do not find either the preſſure or elaſticity of the air remarkably diminiſhed: it is indeed diminiſhed, but by a very ſmall quantity. Reſtoring the former preſſure and elaſticity has not the ſmalleſt tendency to prevent the death of the animal: for an animal will live no longer under a receiver that has its mouth inverted on water, than in one ſet upon the pump-plate covered with leather. Now when the receiver is ſet on water, the preſſure of the atmoſphere acts completely on the included air, and preſerves it in the ſame ſtate of elaſticity.

346 The nature of air when it has maintained animal functions is quite altered.

In ſhort, it is known that the air which has already ſerved to maintain the animal functions has its chemical and alimentary properties completely changed, and is no longer fit for this purpoſe. So much of any maſs of air as has really been thus employed is changed, into what is called *fixed air* by Dr Black, or *carbonic acid* by the chemiſts of the Lavoiſierian ſchool. Any perſon may be convinced of this by breathing or blowing through a pipe immerſed in lime water. Every expiration will produce white clouds on the water, till at the lime which it contains is precipitated in the form of pure chalk. In this caſe we know that the lime has combined with the fixed air.

347 Hale's experiments to reſtore its former qualities, &c.

The celebrated Dr Stephen Hales made many experiments, with a view to clear the air from the noxious vapour which he ſuppoſed to be emitted from the lungs. He made uſe of the apparatus which we have been juſt now mentioning; and he put ſeveral diaphragms *ff*, *ff*, &c. of thin woollen ſtuff into the box, and moiſtened them with various liquids. He found nothing ſo efficacious as a ſolution of potaſh. We now underſtand this perfectly. If the ſolution is not already ſaturated with fixed air, it will take it up as faſt as it is produced, and thus will purify the air: a ſolution of cauſtic alkali therefore will have this effect till it is rendered quite mild.

348 How it comes to be changed by breathing, and the nature of inſpiration, &c.

Theſe experiments have been repeated, and varied in many circumſtances, in order to aſcertain whether this fixed air was really emitted by the lungs, or whether the inſpired air was in part changed into fixed air by its combination with ſome other ſubſtance. This is a queſtion which comes properly in our way, and which the doctrines of pneumatics enable us to anſwer. If the fixed air be emitted in ſubſtance from the lungs, it does not appear how a renewal of the air into which it is emitted is neceſſary; for this does not hinder the ſubſequent emiſſion; and the bulk of the air would be increaſed by breathing in it, viz. by the bulk of all the fixed air emitted; but, on the contrary, it is a little diminiſhed. We muſt therefore adopt the other opinion; and the diſcoveries in modern chemiſtry enable us to gave a pretty accurate account of the whole proceſs. Fixed air is acknowledged to be a compound, of which one ingredient is found to conſtitute about $\frac{3}{8}$ of the whole atmoſpheric fluids; we mean vital air or the oxygene of Lavoiſier. When this is combined with phlogiſton, according to the doctrine of Stahl, or with charcoal, according to Lavoiſier, the reſult is fixed air or carbonic acid. The change therefore which breathing makes on the air is the ſolution of this matter by vital air; and the uſe of air in breathing is the carrying off this noxious principle in the way of ſolution. When therefore the air is already ſo far ſaturated as not to diſſolve this ſubſtance as faſt as it is ſecreted, or muſt be ſecreted in the lungs, the animal ſuffers the pain of ſuffocation, or is otherwiſe mortally affected. Suffocation is not the only conſequence; for we can remain for a number of ſeconds without breathing, and then we begin to feel the true pain of ſuffocation; but thoſe who have been inſtantaneouſly ſtruck down by an inſpiration of fixed air, and afterwards recovered to life, complained of no ſuch pain, and ſeemed to have ſuffered chiefly by a nervous affection. It is ſaid (but we will not vouch for the truth of it), that a perſon may ſafely take a full inſpiration of fixed air, if the paſſages of the noſe be ſhut; and that unleſs theſe nerves are ſtimulated by the fixed air, it is not inſtantaneouſly mortal. But theſe are queſtions out of our preſent line of inquiry. They are queſtions of phyſiology, and are treated of in other places of this work. See ANATOMY and PHYSIOLOGY; ſee alſo LUNGS and RESPIRATION. Our buſineſs is to explain in what manner the preſſure and elaſticity of the air, combined with the ſtructure and mechaniſm of the body, operate in producing this neceſſary ſecretion and removal of the matter diſcharged from the lungs in the act of breathing.

It is well aſcertained, that the ſecretion is made from the maſs of blood during its paſſage through the lungs. The blood delivered into the lungs is of a dark blackiſh colour, and it is there changed into a florid red. In the lungs it is expoſed to the action of the air in a prodigiouſly extended ſurface: for the lungs conſiſt of an inconceivable number of ſmall veſſels or bladders, communicating with each other and with the windwipe. Theſe are filled with air in every inſpiration. Theſe veſſels are every-where in contact with minute blood-veſſels. The blood does not *in toto* come into immediate contact with the air; and it would ſeem that it is only the thin ſerous part of it which is acted on by the air at the mouths of the veſſels or pores, where it ſtands by capillary attraction. Dr Prieſtley found, that venous blood incloſed in thin bladders and other membranes was rendered florid by keeping the bladders in contact with abundance of pure vital air. We know alſo, that breath is moiſt or damp, and *muſt* have acquired this moiſture in the lungs. It is immaterial whether this ſecretion of water or lymph (as the anatomiſts call it) be furniſhed by mere exudation through ſimple pores, or by a vaſcular and organic ſecretion; in either caſe, ſome ingredient of the blood comes in contact with air in the lungs, and there unites with it. This is farther confirmed, by obſerving, that all breathing animals are warmer than the ſurrounding medium, and that by every proceſs in which fixed air is formed from vital air heat is produced. Hence this ſolution in air of ſomething from the blood has been aſſigned by many as the ſource of animal heat. We touch on theſe things in a very tranſitory way in this place, only in order to prove that, for the ſupport of animal life, there muſt be a very extenſive application of air to the blood, and that this is made in the lungs.

The queſtion before us in this place is, How is this brought about by the weight and elaſticity of the air? This is done in two ways; by the action of the muſcles of the ribs, and by the action of the diaphragm and other muſcles of the abdomen. The thorax or cheſt is a great cavity, completely filled by the lungs. The ſides of this cavity are formed by the ribs. Theſe are crooked or arched, and each is moveable round its two ends, one of them being inſerted into the vertebræ, of the back, and the other into the ſternum or breaſt-bone. The rib turns in a manner reſembling the handle of a drawer. The inſpection of fig. 59. will illuſtrate this matter a little. Suppoſe the curves ace, bkf, clg, &c. to repreſent the ribs moveable round the extremities. Each ſucceeding rib is more bent than the one above it, and this curvature is both in the vertical and horizontal direction. Suppoſe each ſo broad as to project a little over its inferior like the tiles of a roof. It is evident, that if we take the lower one by its middle, and draw it out a little, moving it round the line np, it will bring out the next dmh along with it. Alſo, becauſe the diſtance of the middle point o from the axis of motion np is greater than the diſtance of m from the axis dh, and becauſe o will therefore deſcribe a portion of a larger circle than m does, the rib nop will ſlide up a little under the rib dmh, or the rib dmh will overlap nop a little more than before; the diſtance om will therefore be diminiſhed. The ſame muſt happen to all the ſuperior ribs; but the change of diſtance will be leſs and leſs as we go upwards. Now, inſtead of this great breadth of the ribs overlapping each other, ſuppoſe each inferior rib connected with the one above it by threads or fibres ſuſceptible of contraction at the will of man. The articulations e, a, of the firſt or upper rib with the ſpine and ſternum are ſo broad and firm, that this rib can have little or no motion round the line ae; this rib therefore is as a fixture for the ends of all the contracting fibres: therefore, whenever the fibres which connect the ſecond rib with the firſt rib contract, the ſecond muſt riſe a little, and alſo go outward, and will carry the lower ribs along with it; the third rib will riſe ſtill farther by the contraction of the muſcles which connect it with the ſecond, and ſo on: and then the whole ribs are raiſed and thrown outward (and a little forward, becauſe the articulation of each with the ſpine is conſiderably higher than that with the ſternum), and the capacity of the thorax is enlarged by the contraction of its muſcular covering. The direction of the muſcular fibres is very oblique to the direction of the circular motion which it produces; from which circumſtance it follows, that a very minute contraction of the

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Effects of Air's preſſure.

muſcles produces all the motion which is neceſſary. This indeed is not great; the whole motion of the loweſt ribs is leſs than an inch in the moſt violent inſpiration, and the whole contraction of the muſcles of the 12 ribs does not exceed the eighth part of an inch, even ſuppoſing the intercoſtal muſcles at right angles to the ribs; and being oblique, the contraction is ſtill leſs (ſee **Borelli, Sabatier, Monro,** &c.) It would ſeem, that the intenſity of the contractive power of a muſcular fibre is eaſily obtained, but that the ſpace through which it can be exerted is very limited; for in moſt caſes nature places the muſcles in ſituations of great mechanical diſadvantage in this reſpect, in order to procure other conveniences.

But this is not the whole effect of the contraction of the intercoſtal muſcles: ſince the compound action of the two ſets of muſcles, which croſs each other from rib to rib like the letter X, is nearly at right angles to the rib, but is oblique to its plane, it tends to puſh the ribs cloſer on their articulations, and thus to preſs out the two pillars on which they are articulated. Thus, ſuppoſing *a f* (fig. 60.) to repreſent the ſection of one of the vertebræ of the ſpine, and *c d* a ſection of the ſternum, and *a b c*, *f e d*, two oppoſite ribs, with a lax thread *b e* connecting them. If this thread be pulled upwards by the middle *g* till it is tight, it will tend to pull the points *b* and *e* nearer to each other, and to preſs the vertebræ *a f* and the ſternum *cd* outwards. The ſpine being the chief pillar of the body, may be conſidered as immoveable in the preſent inſtance. The ſternum is ſufficiently ſuſceptible of motion for the preſent purpoſe. It remains almoſt fixed a-top to its articulation with the firſt rib, but it gradually yields below; and thus the capacity of the thorax is enlarged in this direction alſo. The whole enlargement of the diameters of the thorax during inſpiration is very ſmall, not exceeding the fiftieth part of an inch in ordinary caſes. This is eaſily calculated. Its quieſcent capacity is about two cubic feet, and we never draw in more than 15 inches. Two ſpheres, one of which holds 2 cubic feet and the other 2 feet and 15 inches, will not differ in diameter above the fiftieth part of an inch.

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The other method of enlarging the capacity of the thorax is very different. It is ſeparated from the abdomen by a ſtrong muſcular partition called the *diaphragm*, which is attached to firm parts all around. In its quieſcent or relaxed ſtate it is conſiderably convex upwards, that is, towards the thorax, riſing up into its cavity like the bottom of an ordinary quart bottle, only not ſo regular in its ſhape. Many of its fibres tend from its middle to the circumference, where they are inſerted into firm parts of the body. Now ſuppoſe theſe fibres to contract. This muſt draw down its middle, or make it flatter than before, and thus enlarge the capacity of the thorax.

Phyſiologiſts are not well agreed as to the ſhare which each of theſe actions has in the operation of enlarging the thorax. Many refuſe all ſhare of it to the intercoſtal muſcles, and ſay that it is performed by the diaphragm alone. But the fact is, that the ribs are really obſerved to riſe even while the perſon is aſleep; and this cannot poſſibly be produced by the diaphragm, as theſe anatomiſts aſſert. Such an opinion ſhows either ignorance or neglect of the laws of pneumatics. If the capacity of the thorax were enlarged only by drawing down the diaphragm, the preſſure of the air would compreſs the ribs, and make them deſcend. And the ſimple laws of mechanics make it as evident as any propoſition in geometry, that the contraction of the intercoſtal muſcles *muſt* produce an elevation of the ribs and enlargement of the thorax: and it is one of the moſt beautiful contrivances of nature. It depends much on the will of the animal what ſhare each of theſe actions ſhall have. In general, the greateſt part is done by the diaphragm; and any perſon can breathe in ſuch a manner that his ribs ſhall remain motionleſs; and on the contrary, he can breathe almoſt entire by raiſing his cheſt. In the firſt method of breathing, the belly riſes during inſpiration, becauſe the contraction of the diaphragm compreſſes the upper part of the bowels, and therefore ſqueezes them outwards; ſo that an ignorant perſon would be apt to think that the breathing was performed by the belly, and that the belly is inflated with the air. The ſtrait lacing of the women impedes the motion of the ribs, and changes the natural habit of breathing, or brings on an unnatural habit. When the mind is depreſſed, it is obſerved that the breathing is more performed by the muſcles of the thorax; and a deep ſigh is always made in this way.

Theſe obſervations on the manner in which the capacity of the cheſt can be enlarged were neceſſary, before we can acquire a juſt notion of the way in which the mechanical properties of air operate in applying it to the maſs of blood during its paſſage through the lungs. Suppoſe the thorax quite empty, and communicating with the external air by means of the trachea or windpipe, it would then reſemble a pair of bellows. Raiſing the boards correſponds to the raiſing of the ribs; and we might imitate the action of the diaphragm by forcibly pulling outwards the folded leather which unites them. Thus their capacity is enlarged, and the air ruſhes in at the nozzle by its weight in the ſame manner as water would do. The thorax differs from bellows only in this reſpect, that it is filled by the lungs, which is a vaſt collection of little bladders, like the holes in a piece of fermented bread, all communicating with the trachea, and many of them with each other. When the cheſt is enlarged, the air ruſhes into them all in the ſame manner as into the ſingle cavity of an empty thorax. It cannot be ſaid with propriety that they are inflated: all that is done is the *allowing* the air to come in. At the ſame time, as their membranous covering muſt have ſome thickneſs, however ſmall, and ſome elaſticity, it is not unlikely that, when compreſſed by expiration, they tend a little to recover their former ſhape, and thus aid the voluntary action of the muſcles. It is in this manner that a ſmall bladder of caoutchouc ſwells again after compreſſion, and fills itſelf with air or water. But this cannot happen except in the moſt minute veſicles: thoſe of ſenſible bulk have not elaſticity enough for this purpoſe. The lungs of birds, however have ſome very large bladders, which have a very conſiderable elaſticity, and recover their ſhape and ſize with great force after compreſſion, and thus fill themſelves with air. The reſpiration of theſe animals is conſiderably different from that of land animals, and their muſcles act chiefly in expiration. This will be explained by and by as a curious variety in the pneumatic inſtrument.

This account of the manner in which the lungs are filled

349 We take in air not by our own action, but by external preſſure.

filled with air does not ſeem agreeable to the notions we entertain of it. We ſeem to ſuck in the air; but although it be true that we act, and exert force, in order to get air into our lungs, it is not by our action, but by external preſſure, that it does come in. If we apply our mouth to the top of a bottle filled with water, we find that no draught, as we call it, of our cheſt will ſuck in any of the water; but if we ſuck in the very ſame manner at the end of a pipe immerſed in water, it follows immediately. Our intereſt in the thing makes us connect in imagination our own action with the effect, without thinking on the many ſteps which may intervene in the train of natural operations; and we conſider the action as the immediate cauſe of the air's reception into the lungs. It is as if we opened the door, and took in by the hand a perſon who was really puſhed in by the crowd without. If an inciſion be made into the ſide of the thorax, ſo that the air can get in by that way, when the animal acts in the uſual manner, the air will really come in by this hole, and fill the ſpace between the lungs and thorax; but no air is ſucked into the lungs by this proceſs, and the animal is as completely ſuffocated as if the windpipe were ſhut up. And, on the other hand, if a hole be made into the lungs without communicating with the thorax, the animal will breathe through this hole, though the windpipe be ſtopped. This is ſucceſsfully performed in caſes of patients whoſe trachea is ſhut up by accident or by inflammation; only it is neceſſary that this perforation be made into a part of the lungs where it may meet with ſome of the great pulmonary paſſages; for if made into ſome remote part of a lobe, the air cannot find its way into the reſt of the lungs through ſuch narrow paſſages, obſtructed too by blood, &c.

350 Nature of exſpiration.

We have now explained, on pneumatical principles, the proceſs of inſpiration. The exſpiration is chiefly performed by the natural tone of the parts. In the act of inſpiration the ribs were raiſed and drawn outwards in oppoſition to the elaſticity of the ſolids themſelves; for although the ribs are articulated at their extremities, the articulations are by no means ſuch as to give a free and eaſy motion like the joints of the limbs. This is particularly the caſe in the articulations with the ſternum, which are by no means fitted for motion. It would ſeem that the motion really produced here is chiefly by the yielding of the cartilaginous parts and the bending of the rib; when therefore the muſcles which produced this effect are allowed to relax, the ribs again collapſe. Perhaps this is aſſiſted a little by the action of the long muſcles which come down acroſs the ribs without being inſerted into them. Theſe may draw them together a little, as we compreſs a looſe bundle by a ſtring.

In like manner, when the diaphragm was drawn down, it compreſſed the abdomen in oppoſition to the elaſticity of all the viſcera contained in it, and to the elaſticity and tone of the teguments and muſcles which ſurround it. When therefore the diaphragm is relaxed, theſe parts puſh it up again into its natural ſituation, and in doing this expel the air from the lungs.

351 It requires no effort.

If this be a juſt account of the matter, exſpiration ſhould be performed without any effort. This accordingly is the caſe. We feel that, after having made an ordinary eaſy inſpiration, it requires the continuance of the effort to keep the thorax in this enlarged ſtate, and that all that is neceſſary for exſpiration is to ceaſe to act. No perſon feels any difficulty in emptying the lungs; but weak people often feel a difficulty of inſpiration, and compare it to the feeling of a weight on their breaſt; and exſpiration is the laſt motion of the thorax in a dying perſon.

But nature has alſo given us a mechaniſm by which we can exſpire, namely, the abdominal muſcles; and when we have finiſhed an ordinary and eaſy exſpiration, we can ſtill expel a conſiderable bulk of air (nearly half of the contents of the lungs) by contracting the abdominal muſcles. Theſe, by compreſſing the body, force up its moveable contents againſt the diaphragm, and cauſe it to riſe further into the thorax, acting in the ſame manner as when we expel the fæces *per anum*. When a perſon breathes out as much air as he can in this manner, he may obſerve that his ribs do not collapſe during the whole operation.

352 A certain quantity of air neceſſary to keep the lungs of a natural ſize.

There ſeems then to be a certain natural unconſtrained ſtate of the veſicles of the lungs, and a certain quantity of air neceſſary for keeping them of this ſize. It is probable that this ſtate of the lungs gives the freeſt motion to the blood. Were they more compreſſed, the blood-veſſels would be compreſſed by the adjoining veſicles; were they more lax, the veſſels would be more crooked and by this means obſtructed. The frequent inſpirations gradually change this air by mixing freſh air with it, and at every exſpiration carrying off ſome of it. In catarrhs and inflammations, eſpecially when attended with ſuppuration, the ſmall paſſages into the remote veſſels are obſtructed, and thus the renewal of air in them will be prevented. The painful feeling which this occaſions cauſes us to expel the air with violence, ſhutting the windpipe till we have exerted ſtrongly with the abdominal muſcles, and made a ſtrong compreſſion on the lower part of the thorax. We then open the paſſage ſuddenly, and expel the air and obſtructing matter by violent coughing.

353 Proceſs of breathing in birds.

We have ſaid, that birds exhibit a curious variety in the proceſs of breathing. The muſcles of their wings being ſo very great, required a very extenſive inſertion, and this is one uſe of the great breaſt-bone. Another uſe of it is, to form a firm partition to hinder the action of theſe muſcles from compreſſing the thorax in the act of flying: therefore the form of their cheſt does not admit of alternate enlargement and contraction to that degree as in land animals. Moreover, the muſcles of their abdomen are alſo very ſmall; and it would ſeem that they are not ſufficient for producing the compreſſion on the bowels which is neceſſary for carrying on the proceſs of concoction and digeſtion. Inſtead of aiding the lungs, they receive help from them.

Plate CCCCV.

In an oſtrich, the lungs conſiſt of a fleſhy part A, A (fig. 61.), compoſed of veſicles like thoſe of land animals, and, like theirs, ſerving to expoſe the blood to the action of the air. Beſides theſe, they have on each ſide four large bags B, C, D, E, each of which has an orifice G communicating with the trachea; but the ſecond, C, has alſo an orifice H, by which it communicates with another bag F ſituated below the reſt in the abdomen. Now when the lungs are compreſſed by the action of the diaphragm, the air in C is partly expelled by the trachea through the orifice G, and partly driven through the orifice H into the bag F,

which

Effects of Air's preſſure

Effects of Air's preſſure.

which is then allowed to receive it; becauſe the ſame action which compreſſes the lungs enlarges the abdomen. When the thorax is enlarged, the bag C is partly ſupplied with freſh air through the trachea, and partly from the bag F. As the lungs of other animals reſemble a common bellows, the lungs of birds reſemble the ſmith's bellows with a partition; and anatomiſts have diſcovered paſſages from this part of the lungs into their hollow bones and quills. We do not know all the uſes of this contrivance; and only can obſerve, that this alternate action muſt aſſiſt the muſcles of the abdomen in promoting the motion of the food along the alimentary canal, &c. We can diſtinctly obſerve in birds that their belly dilates when the cheſt collapſes, and *vice verſa*, contrary to what we ſee in the land animals. Another uſe of this double paſſage may be to produce a circulation of air in the lungs, by which a compenſation is made for the ſmaller ſurface of action on the blood: for the number of ſmall veſicles, of equal capacity with theſe large bags, gives a much more extenſive ſurface.

If we try to raiſe mercury in a pipe by the action of the cheſt alone, we cannot raiſe it above two or three inches; and the attempt is both painful and hazardous. It is painful chiefly in the breaſt, and it provokes coughing. Probably the fluids ooze through the pores of the veſicles by the preſſure of the ſurrounding parts.

On the other hand, we can by exſpiration ſupport mercury about five or ſix inches high: but this alſo is very painful, and apt to produce extravaſation of blood. This ſeems to be done entirely by the abdominal muſcles.

354 The operation of ſucking.

The operation properly termed SUCKING is totally different from breathing, and reſembles exceedingly the action of a common pump. Suppoſe a pipe held in the mouth, and its lower end immerſed in water. We fill the mouth with the tongue, bringing it forward, and applying it cloſely to the teeth and to the palate; we then draw it back, or bend it downwards (behind) from the palate, thus leaving a void. The preſſure of the air on the cheeks immediately depreſſes them, and applies them cloſe to the gums and teeth; and its preſſure on the water in the veſſel cauſes it to riſe through the pipe into the empty part of the mouth, which it quickly fills. We then puſh forward the tip of the tongue, below the water, to the teeth, and apply it to them all round, the water being above the tongue, which is kept much depreſſed. We then apply the tongue to the palate, beginning at the tip, and gradually going backwards in this application. By this means the water is gradually forced backward by an operation ſimilar to that of the gullet in ſwallowing. This is done by contracting the gullet above and relaxing it below, juſt as we would empty a gut of its contents by drawing our cloſed hand along it. By this operation the mouth is again completely occupied by the tongue, and we are ready for repeating the operation. Thus the mouth and tongue reſemble the barrel and piſton of a pump; and the application of the tip of the tongue to the teeth performs the office of the valve at the bottom of the barrel, preventing the return of the water into the pipe. Although uſual, it is not abſolutely neceſſary, to withdraw the tip of the tongue, making a void before the tongue. Sucking may be performed by merely ſeparating the tongue gradually from the palate, beginning at the root. If we withdraw the tip of the tongue a very minute quantity, the water gets in and flows back above the tongue.

The action of the tongue in this operation is very powerful; ſome perſons can raiſe mercury 25 inches: but this ſtrong exertion is very fatiguing, and the ſoft parts are prodigiouſly ſwelled by it. It cauſes the blood to ooze plentifully through the pores of the tongue, fauces, and palate, in the ſame manner as if a cupping-glaſs and ſyringe were applied to them; and, when the inſide of the mouth is excoriated or tender, as is frequent with infants, even a very moderate exertion of this kind is accompanied with extravaſation of blood. When children ſuck the nurſes breaſt, the milk follows their exertion by the preſſure of the air on the breaſt; and a weak child, or one that withholds its exertions on account of pain from the above-mentioned cauſe, may be aſſiſted by a gentle preſſure of the hand on the breaſt: the infant pupil of nature, without any knowledge of pneumatics, frequently helps itſelf by preſſing its face to the yielding breaſt.

In the whole of this operation the breathing is performed through the noſtrils; and it is a prodigious diſtreſs to an infant when this paſſage is obſtructed by mucus. We beg to be forgiven for obſerving by the way, that this obſtruction may be almoſt certainly removed for a little while, by rubbing the child's noſe with any liquid of quick evaporation, or even with water.

355 And of drinking, which is very ſimilar.

The operation in drinking is not very different from that in ſucking: we have indeed little occaſion here to ſuck, but we muſt do it a little. Dogs and ſome other animals cannot drink, but only lap the water into their mouths with their tongue, and then ſwallow it. The gallinaceous birds ſeem to drink very imperfectly; they ſeem merely to dip their head into the water up to the eyes till their mouth is filled with water, and then holding up the head, it gets into the gullet by its weight, and is then ſwallowed. The elephant drinks in a very complicated manner; he dips his trunk into the water, and fills it by making a void in his mouth: this he does in the contrary way to man. After having depreſſed his tongue, he begins the application of it to the palate at the root, and by extending the application forward, he expels the air by the mouth which came into it from the trunk. The proceſs here is not very unlike that of the condenſing ſyringe without a piſton valve, deſcribed in n° 58, in which the external air (correſponding here to the air in the trunk) enters by the hole F in the ſide, and is expelled through the hole in the end of the barrel; by this operation the trunk is filled with water: then he lifts his trunk out of the water, and bringing it to his mouth, pours the contents into it, and ſwallows it. On conſidering this operation, it appears that, by the ſame proceſs by which the air of the trunk is taken into the mouth, the water could alſo be taken in, to be afterwards ſwallowed: but we do not find, upon inquiry, that this is done by the elephant; we have always obſerved him to drink in the manner now deſcribed. In either way it is a double operation, and cannot be carried on any way but by alternately ſucking and ſwallowing, and while one operation is going on the other is interrupted; whereas man can do both at the ſame time. Nature ſeems to delight in exhibiting to rational obſervers her inexhauſtible variety of reſource; for many inſects, which drink with a trunk, drink without interruption; yet we do not call in queſtion the truth of the aphoriſm, *Natura maxime ſimplex et ſemper ſibi conſona*, nor doubt but that if the *whole* of her purpoſe were ſeen, we ſhould find that her proceſs is the ſimpleſt poſſible: for Nature, or Nature's God, is wiſe above our wiſeſt thoughts, and ſimplicity is certainly the choice of wiſdom: but alas! it is generally but a ſmall and the moſt obvious part of her purpoſe that we can obſerve or appreciate. We ſeldom ſee this ſimplicity of nature ſtated to us, except by ſome ſyſtem-maker who has found a principle which ſomehow tallies with a conſiderable variety of phenomena, and then cries out, *Fruſtra fit per plura quod fieri poteſt per pauciora*.

356 Mode of keeping up a continued blaſt with a blow-pipe.

There is an operation ſimilar to that of the elephant, which many find a great difficulty in acquiring, viz. keeping up a continued blaſt with a blow-pipe. We would deſire our chemical reader to attend minutely to the gradual action of his tongue in ſucking, and he will find it ſuch as we have deſcribed. Let him attend particularly to the way in which the tip of the tongue performs the office of a valve, preventing the return of the water into the pipe: the ſame poſition of the tongue would hinder air from coming into the mouth. Next let him obſerve, that in ſwallowing what water he has now got lodged above his tongue, he continues the tip of the tongue applied to the teeth; now let him ſhut his mouth, keeping his lips firm together, the tip of the tongue at the teeth, and the whole tongue forcibly kept at a diſtance from the palate; bring up the tongue to the palate, and allow the tip to ſeparate a little from the teeth; this will expel the air into the ſpace between the fauces and cheeks, and will blow up the cheeks a little: then, acting with the tip of the tongue as a valve, hinder this air from getting back, and depreſſing the tongue again, more air (from the noſtrils) will get into the mouth, which may be expelled into the ſpace without the teeth as before, and the cheeks will be more inflated: continue this operation, and the lips will no longer be able to retain it, and it will ooze through as long as the operation is continued. When this has become familiar and eaſy, take the blow-pipe, and there will be no difficulty in maintaining a blaſt as uniform as a ſmith's bellows, breathing all the while through the noſtrils. The only difficutly is the holding the pipe: this fatigues the lips but it may be removed by giving the pipe a convenient ſhape, a pretty flat oval, and wrapping it round with leather or thread.

Another phenomenon depending on the principles already eſtabliſhed, is the land and ſea-breeze in the warm countries.

357 Nature of the land and ſea breeze in warm countries.

We have ſeen that air expands exceedingly by heat; therefore heated air, being lighter than an equal bulk of cold air, muſt riſe in it. If we lay a hot ſtone in the ſunſhine in a room, we ſhall obſerve the ſhadow of the ſtone ſurrounded with a fluttering ſhadow of different degrees of brightneſs, and that this flutter riſes rapidly in a column above the ſtone. If we hold an extinguiſhed candle near the ſtone, we ſhall ſee the ſmoke move towards the ſtone, and then aſcend up from it. Now, ſuppoſe an iſland receiving the firſt rays of the ſun in a perfectly calm morning; the ground will ſoon be warmed, and will warm the contiguous air. If the iſland be mountainous, this effect will be more remarkable; becauſe the inclined ſides of the hills will receive the light more directly: the midland air will therefore be moſt warmed: the heated air will riſe, and that in the middle will riſe faſteſt; and thus a current of air upwards will begin, which muſt be ſupplied by air coming in from all ſides, to be heated and to riſe in its turn; and thus the morning *ſea-breeze* is produced, and continues all day. This current will frequently be reverſed during the night, by the air cooling and gliding down the ſides of the hills, and we ſhall have the *land-breeze*.

358 Circulation of air in mines.

It is owing to the ſame cauſe that we have a circulation of air in mines which have the mouths of their ſhafts of unequal heights. The temperature underground is pretty conſtant through the whole year, while that of the atmoſphere is extremely variable. Now, ſuppoſe a mine having a long horizontal drift, communicating between two pits or ſhafts, and that one of theſe ſhafts terminates in a valley, while the other opens on the brow of a hill perhaps 100 feet higher. Let us further ſuppoſe it ſummer, and the air heated to 65°, while the temperature of the earth is but 45°; this laſt will be alſo the temperature of the air in the ſhafts and the drift. Now, ſince air expands nearly 24 parts in 10000 by one degree of heat, we ſhall have an odds of preſſure at the bottom of the two ſhafts equal to nearly the 20th part of the weight of a column of air 100 feet high (100 feet being ſuppoſed the difference of the heights of the ſhafts.). This will be about ſix ounces on every ſquare foot of the ſection of the ſhaft. If this preſſure could be continued, it would produce a prodigious current of air down the long ſhaft, along the drift, and up the ſhort ſhaft. The weight of the air acting through 100 feet would communicate to it the velocity of 80 feet *per* ſecond: divide this by $\sqrt{20}$, that is, by 4,5, and we ſhall have 18 feet *per* ſecond for the velocity: this is the velocity of what is called a briſk gale. This preſſure *would* be continued, if the warm air which enters the long ſhaft were cooled and condenſed as faſt as it comes in; but this is not the caſe. *It is however cooled* and condenſed, and a current is produced ſufficient to make an abundant circulation of air along the whole paſſage; and care is taken to diſpoſe the ſhafts and conduct the paſſages in ſuch a manner that no part of the mine is out of the circle. When any new lateral drift is made, the renewal of air at its extremity becomes more imperfect as it advances; and when it is carried a certain length, the air ſtagnates and becomes ſuffocating, till either a communication can be made with the reſt of the mine, or a ſhaft be made at the end of this drift.

As this current depends entirely on the difference of temperature between the air below and that above, it muſt ceaſe when this difference ceaſes. Accordingly, in the ſpring and autumn, the miners complain much of ſtagnation; but in ſummer they never want a current from the deep pits to the ſhallow, nor in the winter a current from the ſhallow pits to the deep ones. It frequently happens alſo, that in mineral countries the chemical changes which are going on in different parts of the earth make differences of temperature ſufficient to produce a ſenſible current.

It is eaſy to ſee that the ſame cauſes muſt produce a current down our chimneys in ſummer. The chimney is colder than the ſummer air, and muſt therefore condenſe it, and it will come down and run out at the doors and windows.

359 The nature of what is called the draught in chimneys.

And this naturally leads us to conſider a very important effect of the expanſion and conſequent aſcent of air by heat, namely the drawing (as it is called) of chimneys. The air which has contributed to the burning of fuel muſt be intenſely heated, and will riſe in the atmoſphere. This will alſo be the caſe with much of the ſurrounding air which has come very near the fire, although not in contact with it. If this heated air be made to riſe in a pipe, it will be kept together, and thereſore will not ſoon cool and collapſe: thus we ſhall obtain a long column of light air, which will riſe with a force ſo much the greater as the column is longer or more heated. Therefore the taller we make the chimney, or the hotter we make the fire, the more rapid will be the current, or the draught or ſuction, as it is injudiciouſly called, will be ſo much the greater. The aſcenſional force is the difference between the weight of the column of heated air in the funnel and a column of the ſurrounding atmoſphere of equal height. We increaſe the draught, therefore, by increaſing the perpendicular height of the chimney. Its length in a horizontal direction gives no increaſe, but, on the contrary, diminiſhes the draught by cooling the air before it gets into the effective part of the funnel. We increaſe the draught alſo by obliging all the air which enters the chimney to come very near the fuel; therefore a low mantle piece will produce this effect; alſo filling up all the ſpaces on each ſide of the grate. When much air gets in above the fire, by having a lofty mantlepiece, the general maſs of air in the chimney cannot be much heated, Hence it muſt happen that the greateſt draught will be produced by bringing down the mantlepiece to the very fuel; but this converts a fire-place into a furnace, and by thus ſending the whole air through the fuel, cauſes it to burn with great rapidity, producing a prodigious heat; and this producing an increaſe of aſcenſional force, the current becomes furiouſly rapid, and the heat and conſumption of fuel immenſe. If the fire-place be a cube of a foot and a half and the front cloſed by a door, ſo that all the air muſt enter through the bottom of the grate, a chimney of 15 or 20 feet high, and ſufficiently wide to give paſſage to all the expanded air which can paſs through the fire, will produce a current which will roar like thunder, and a heat ſufficient to run the whole inſide into a lump of glaſs.

All that is neceſſary, however, in a chamber fireplace is a current ſufficiently great for carrying up the ſmoke and vitiated air of the fuel. And as we want alſo the enlivening flutter and light of the fire, we give the chimney piece both a much greater height and width than what is merely neceſſary for carrying up the ſmoke, only wiſhing to have the current ſufficiently determinate and ſteady for counteracting any occaſional tendency which it may ſometimes have to come into the room. By allowing a greater quantity of air to get into the chimney, heated only to a moderate degree, we produce a more rapid renewal of the air of the room: did we oblige it to come ſo much nearer the fire as to produce the ſame renewal of the air in conſequence of a more rapid current, we ſhould produce an inconvenient heat. But in this country, where pit-coal is in general ſo very cheap, we carry this indulgence to an extreme; or rather we have not ſtudied how to get all the deſired advantages with economy. A much ſmaller renewal of air than we commonly produce is abundantly wholeſome and pleaſant, and we may have all the pleaſure of the light and flame of the fuel at much leſs expence, by contracting greatly the paſſage into the vent. The beſt way of doing this is by contracting the brick work on each ſide behind the mantlepiece, and reducing it to a narrow parallelogram, having the back of the vent for one of its long ſides. Make an iron plate to fit this hole, of the ſame length, but broader, ſo that it may lie ſloping, its lower edge being in contact with the foreſide of the hole, and its upper edge leaning on the back of the vent. In this poſition it ſhuts the hole entirely. Now let the plate have a hinge along the front or lower edge, and fold up like the lid of a cheſt. We ſhall thus be able to enlarge the paſſage at pleaſure. In a fire place fit for a room of 24 feet by 18, if this plate may be about 18 inches long from ſide to ſide, and folded back within an inch or an inch and a half of the wall, this will allow paſſage for as much air as will keep up a very cheerful fire; and by raiſing or lowering this REGISTER, the fire may be made to burn more or leſs rapidly. A free paſſage of half an inch will be ſufficient in weather that is not immoderately cold. The principle on which this conſtruction produces its effect is, that the air which is in the front of the fire, and much warmed by it, is not allowed to get into the chimney, where it would be immediately hurried up the vent, but riſes up to the ceiling and is diffuſed over the whole room. This double motion of the air may be diſtinctly obſerved by opening a little of the door and holding a candle in the way. If the candle be held near the floor, the flame will be blown into the room; but if held near the top of the door, the flame will be blown outward.

360 Deſcription of a ſtove-grate or chapelle.

But the moſt perfect method of warming an apartment in theſe temperate climates, where we can indulge in the cheerfulneſs and ſweet air produced by an open fire, is what we call a ſtove-grate, and our neighbours on the continent call a chapelle, from its reſemblance to the chapels or oratories in the great churches.

In the great chimney-piece, which, in this caſe, may be made even larger than ordinary, is ſet a ſmaller one fitted up in the ſame ſtile of ornament, but of a ſize no greater than is ſufficient for holding the fuel. The ſides and back of it are made of iron (caſt iron is preferable to hammered iron, becauſe it does not ſo readily calcine), and are kept at a ſmall diſtance from the ſides and back of the main chimney-place, and are continued down to the hearth, ſo that the aſh-pit is alſo ſeparated. The pipe or chimney of the ſtove grate is carried up behind the ornaments of the mantle-piece till it riſes above the mantle-piece of the main chimney-piece, and it is fitted with a regiſter or damper-plate turning round a tranſverſe axis. The beſt form of this regiſter is that which we have recommended for an ordinary fire-place, having its axis or joint cloſe at the front; ſo that when it is open or turned up, the burnt air and ſmoke ſtriking it obliquely, are directed with certainty into the vent, without any riſk of reverberating and coming out into the room. All the reſt of the vent is ſhut up by iron plates or brick-work out of ſight.

361 Effects of its conſtruction.

The effect of this conſtruction is very obvious. The fuel, being in immediate contact with the back and ſides of the grate, heat them to a great degree, and they heat the air contiguous to them. This heated air cannot get up the vent, becauſe the paſſages above theſe ſpaces are ſhut up. It therefore comes out into the room; ſome of it goes into the real fire place and is carried up the vent, and the reſt riſes to the ceiling and is diffuſed over the room.

It is ſurpriſing to a perſon who does not conſider it with ſkill how powerfully this grate warms a room. Leſs than one-fourth of the fuel conſumed in an ordinary fire-place is ſufficient; and this with the ſame cheerful blazing hearth and ſalutary renewal of air. It even requires attention to keep the room cool enough. The heat communicated to thoſe parts in contact with the fuel is needleſsly great; and it will be a conſiderable improvement to line this part with very thick plates of caſt iron, or with tiles made of fire-clay which will not crack with the heat. Theſe, being very bad conductors, will make the heat, ultimately communicated to the air, very moderate. If, with all theſe precautions, the heat ſhould be found too great, it may be brought under perfect management by opening paſſages into the vent from the lateral ſpaces. Theſe may be valves or trap doors moved by rods concealed behind the ornaments.

Thus we have a fire-place under the moſt complete regulation, where we can always have a cheerful fire without being for a quarter of an hour incommoded by the heat; and we can as quickly raiſe our fire, when too low, by hanging on a plate of iron on the front, which ſhall reach as low as the grate. This in five minutes will blow up the fire into a glow; and the plate may be ſent out of the room, or ſet behind the ſtove-grate out of ſight.

The propriety of incloſing the aſh-pit is not ſo obvious; but if this be not done, the light aſhes, not finding a ready paſſage up the chimney, will come out into the room along with the heated air.

We do not conſider in this place the various extraneous circumſtances which impel the current of air in our chimneys and produce ſmoky houſes: theſe will be treated of, and the methods of removing or remedying them, under the article SMOKE. We conſider at preſent only the theory of this motion in general, and the modifications of its operation ariſing from the various purpoſes to which it may be applied.

362
Mode of warming apartments by ſtoves.

Under this head we ſhall next give a general account and deſcription of the method of warming apartments by ſtoves. A STOVE in general is a fire-place ſhut up on all ſides, having only a paſſage for admitting the air to ſupport the fire, and a tube for carrying off the vitiated air and ſmoke; and the air of the room is warmed by coming into contact with the outſide of the ſtove and flue. The general principle of conſtruction, therefore, is very ſimple. The air muſt be made to come into as cloſe contact as poſſible with the fire, or even to paſs through it, and this in ſuch quantities as juſt to conſume a quantity of fuel ſufficient for producing the heat required; and the ſtove muſt be ſo conſtructed, that both the burning fuel and the air which has been heated by it ſhall be applied to as extenſive a ſurface as poſſible of furnace all in contact with the air of the room; and the heated air within the ſtove muſt not be allowed to get into the funnel which is to carry it off till it is too much cooled to produce any conſiderable heat on the outſide of the ſtove.

In the temperate climates no great ingenuity is neceſſary for warming an ordinary apartment; and ſtoves are made rather to pleaſe the the eye as furniture than as economical ſubſtitutes for an open fire of equal calorific power. But the inhabitants of cold countries, and eſpecially towards the north, where the cold of winter is intenſe and fuel very dear, have beſtowed much attention on their conſtruction, and have combined ingenious economy with every elegance of form Nothing can be handſomer than the ſtoves of Fayencerie that are to be ſeen in French Flanders, or the Ruſſian ſtoves at St Peterſburgh, finiſhed in ſtucco. Our readers will not therefore, be diſpleaſed with a deſcription of them. In this place, however, we ſhall only conſider a ſtove in general as a ſubject of pneumatical diſcuſſion, and we refer our readers to the article STOVE for an account of them as articles of domeſtic accommodation.

363
General form of a ſtove.

Plate CCCCV.

The general form, therefore, of a ſtove, and of which all others are only modifications adapted to circumſtances of utility or taſte, is as follows:

MIKL (fig. 62.) is a quadrangular box of any ſize in the directions MI, IK. The inſide width from front to back is pretty conſtant, never leſs than ten inches, and rarely extending to 20; the included ſpace is divided by a great many partitions. The loweſt chamber AB is the receptacle for the fuel, which lies on the bottom of the ſtove without any grate: this fire-place has a door AO turning on hinges, and in this door is a very ſmall wicket P: the roof of the fire-place extends to within a very few inches of the farther end, leaving a narrow paſſage B for the flame. The next partition *c* C is about eight inches higher, and reaches almoſt to the other end, leaving a narrow paſſage for the flame at C. The partitions are repeated above, at the diſtance of eight inches, leaving paſſages at the ends, alternately diſpoſed as in the figure; the laſt of them H communicates with the room vent. This communication may be regulated by a plate of iron, which can be ſlid acroſs it by means of a rod or handle which comes through the ſide. The more uſual way of ſhutting up this paſſage is by a ſort of pan or bowl of earthen ware, which is whelmed over it with its brim reſting in ſand contained in a groove formed all round the hole. This damper is introduced by a door in the front, which is then ſhut. The whole is ſet on low pillars, ſo that its bottom may be a few inches from the floor of the room: it is uſually placed in a corner, and the apartments are ſo diſpoſed that their chimneys can be joined in ſtacks as with us.

Some ſtraw or wood-ſhavings are firſt burnt on the hearth at its farther end. This warms the air in the ſtove, and creates a determined current. The fuel is then laid on the hearth cloſe by the door, and pretty much piled up. It is now kindled; and the current being already directed to the vent, there is no danger of any ſmoke coming out into the room. Effectually to prevent this, the door is ſhut, and the wicket P opened. The air ſupplied by this, being directed to the middle or bottom of the fuel, quickly kindles it, and the operation goes on.

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Aim and effects of this conſtruction.

The aim of this conſtruction is very obvious. The flame and heated air are retained as long as poſſible within the body of the ſtove by means of the long paſſages; and the narrowneſs of theſe paſſages obliges the flame to come in contact with every particle of ſoot, ſo as to conſume it completely, and thus convert the whole combuſtible matter of the fuel into heat. For want of this a very conſiderable portion of our fuel is waſted by our open fires, even under the very beſt management: the ſoot which ſticks to our vents is very inflammable, and a pound weight of it will give as much if not more heat than a pound of coal. And what ſticks to our vents is very inconſiderable in compariſon with what eſcapes unconſumed at the chimney top. In fires of green wood, peat, and ſome kinds of pit-coal, nearly $\frac{1}{3}$ of the fuel is loſt in this way; but in theſe ſtoves there is hardly ever any mark of ſoot to be ſeen; and even this ſmall quantity is produced only after lighting the fires. The volatile inflammable matters are expelled from parts much heated indeed, but not ſo hot as to burn; and ſome of it charred or half-burnt cannot be any further conſumed, being inveloped in flame and air already vitiated and unfit for combuſtion. But when the ſtove is well heated, and the current briſk, no part of the ſoot eſcapes the action of the air.

The hot air retained in this manner in the body of the ſtove is applied to its ſides in a very extended ſurface. To increaſe this ſtill more, the ſtove is made narrower from front to back in its upper part; a certain breadth is neceſſary below, that there may be room for fuel. If this breadth were preſerved all the way up, much heat would be loſt, becauſe the heat communicated to the partitions of the ſtove does no good. By diminiſhing their breadth, the proportion of uſeful ſurface is increaſed. The whole body of the ſtove may be conſidered as a long pipe folded up, and its effects would be the greateſt poſſible if it really were ſo; that is, if each partition *c*C, *d*D, &c. were ſplit into two, and a free paſſage allowed between them for the air of the room. Something like this will be obſerved afterwards in ſome German ſtoves.

It is with the ſame view of making an extenſive application of a hot ſurface to the air, that the ſtove is not built in the wall, nor even in contact with it, nor with the floor: for by its detached ſituation, the air in contact with the back, and with the bottom (where it is hotteſt), is warmed, and contributes at leaſt one half of the whole effect; for the great heat of the bottom makes its effect on the air of the room at leaſt equal to that of the two ends. Sometimes a ſtove makes part of the wall between two ſmall rooms, and is found ſufficient.

It muſt be remarked, on the whole, that the effect of a ſtove depends much on keeping in the room the air already heated by it. This is ſo remarkably the caſe, that a ſmall open fire in the ſame room will be ſo far from increaſing its heat, that it will greatly diminiſh it: it will even draw the warm air from a ſuit of adjoining apartments. This is diſtinctly obſerved in the houſes of the Engliſh merchants in St Peterſburg: their habits of life in Britain make them uneaſy without an open fire in their ſitting rooms; and this obliges them to heat all their ſtoves twice a day, and their houſes are cooler than thoſe of the Ruſſians who heat them only once. In many German houſes, eſpecially of the lower claſs, the fire-place of the ſtove does not open into the room, but into the yard or a lobby, where all the fires are lighted and tended; by this means is avoided the expence of warm air which muſt have been carred off by the ſtove: but it is evident, that this muſt be very unpleaſant, and cannot be wholeſome. We muſt breathe the ſame quantity of ſtagnant air loaded with all the vapours and exhalations which muſt be produced in every inhabited place. Going into one of theſe houſes from the open air, is like putting one's head into a ſtew-pan or under a pie-cruſt, and quickly nauſeates us who are accuſtomed to freſh air and cleanlineſs. In theſe countries it is a matter almoſt of neceſſity, to fumigate the rooms with frankincenſe and other gums burnt. The cenſer in ancient worſhip was in all probability an utenſil introduced by neceſſity for ſweetening or rendering tolerable the air of a crouded place: and it is a conſtant practice in the Ruſſian houſes for a ſervant to go round the room after dinner, waving a cenſer with ſome gums burning on bits of charcoal.

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Of hot walls in gardening, &c.

The account now given of ſtoves for heating rooms, and of the circumſtances which muſt be attended to in their conſtruction, will equally apply to hot walls in gardening, whether within or without doors. The only new circumſtance which this employment of a flue introduces, is the attention which muſt be paid to the equability of the heat, and the gradation which muſt be obſerved in different parts of the building. The heat in the flue gradually diminiſhes as it recedes from the fire-place, becauſe it is continually giving out heat to the flue. It muſt therefore be ſo conducted through the building by frequent returns, that in every part there may be a mixture of warmer and cooler branches of the flue, and the final chimney ſhould be cloſe by the fire-place. It would, however, be improper to run the flue from the end of the floor up to the ceiling, where the ſecond horizontal pipe would be placed, and then return it downward again and make the third horizontal flue adjoining to the firſt, &c. This would make the middle of the wall the coldeſt. If it is the flue of a greenhouſe, this would be highly improper, becauſe the upper part of the wall can be very little employed; and in this caſe it is better to allow the flue to proceed gradually up the wall in its different returns, by which the loweſt part would be the warmeſt, and the heated air will aſcend among the pots and plants; but in a hot wall, where the trees are to receive heat by contact, ſome approximation to the above method may be as uſeful.

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Malt-kilns a ſpecies of ſtove.

In the hypocauſta and ſudaria of the Greeks and Romans, the flue was conducted chiefly under the floors.

Malt-kilns are a ſpecies of ſtove which merit our attention. Many attempts have been made to improve them on the principle of flue ſtoves; but they have been unſucceſsful, becauſe heat is not what is chiefly wanted in malting: it is a copious current of very dry air to carry off the moiſture. We muſt refer the examination of this ſubject alſo to the article STOVE, and proceed to conſider the current of heated air in the chief varieties of furnaces.

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Of the current of air in melting furnaces.

All that is to be attended to in the different kinds of melting furnaces is, that the current of air be ſufficiently rapid, and that it be applied in as extenſive a ſurface as poſſible to the ſubſtance to be melted. The more rapid the current it is the hotter, becauſe it is conſuming more fuel; and therefore its effect increaſes in a higher proportion than its rapidity. It is doubly effectual if twice as hot; and if it then be twice as rapid, there is twice the quantity of doubly hot air applied to the ſubject; it would therefore be four times more powerful. This is procured by raiſing the chimney of the furnace to a greater height. The cloſe application of it to the ſubject can hardly be laid down in general terms, becauſe

cauſe it depends on the preciſe circumſtances of each caſe.

368 In reverberatory furnaces.

In reverberatory furnaces, ſuch as refining furnaces for gold, ſilver, and copper, the flame is made to play over the ſurface of the melted metal. This is produced entirely by the form of the furnace, by making the arch of the furnace as low as the circumſtances of the manipulation will allow (See **Furnace**, p. 509). Experience has pointed out in general the chief circumſtances of their conſtruction, viz. that the fuel ſhould be at one end on a grate, through which the air enters to maintain the fire; and that the metal ſhould be placed on a level floor between the fuel and the tall chimney which produces the current. But there is no kind of furnace more variable in its effect, and almoſt every place has a ſmall peculiarity of conſtruction, on which its pre-eminence is reſted. This has occaſioned many whimſical varieties in their form. This uncertainty ſeems to depend much on a circumſtance rather foreign to our preſent purpoſe; but as we do not obſerve it taken notice of by mineralogical writers, we beg leave to mention it here. It is not heat alone that is wanted in the refining of ſilver by lead, for inſtance. We muſt make a continual application to its ſurface of air, which has not contributed to the combuſtion of the fuel. Any quantity of the hotteſt air, already ſaturated with the fuel, may play on the ſurface of the metal for ever, and keep it in the ſtate of moſt perfect fuſion, but without refining it in the leaſt. Now, in the ordinary conſtruction of a furnace, this is much the caſe. If the whole air has come in by the grate, and paſſed through the middle of the fuel, it can hardly be otherwiſe than nearly ſaturated with it; and if air be alſo admitted by the door (which is generally done or ſomething equivalent), the pure air lies above the vitiated air, and during the paſſage along the horizontal part of the furnace, and along the ſurface of the metal, it ſtill keeps above it, at leaſt there is nothing to promote their mixture. Thus the metal does not come into contact with air fit to act on the baſe metal and calcine it, and the operation of refining goes on ſlowly. Trifling circumſtances in the form of the arch or canal may tend to promote the jumbling of the airs together, and thus render the operation more expeditious; and as theſe are but ill underſtood, or perhaps this circumſtance not attended to, no wonder that we ſee theſe conſidered as ſo many noſtrums of great importance. It were therefore worth while to try the effect of changes in the form of the roof directed to this very circumſtance. Perhaps ſome little prominence down from the arch of the reverberatory would have this effect, by ſuddenly throwing the current into confuſion. If the additional length of paſſage do not cool the air too much, we ſhould think that if there were interpoſed between the fuel and the refining floor a paſſage twiſted like a cork-ſcrew, making juſt half a turn, it would be moſt effectual: for we imagine, that the two airs, keeping each to their reſpective ſides of the paſſage, would by this means be turned upſide down, and that the pure ſtratum would now be in contact with the metal, and the vitiated air would be above it.

369 And in the glaſs houſe furnaces.

The glaſshouſe furnace exhibits the chief variety in the management of the current of heated air. In this it is neceſſary that the hole at which the workman dips his pipe into the pot ſhall be as hot as any part of the furnace. This could never be the caſe, if the furnace had a chimney ſituated in a part above the dipping-hole; for in this caſe cold air would immediately ruſh in at the hole, play over the ſurface of the pot, and go up the chimney. To prevent this the hole itſelf is made the chimney; but as this would be too ſhort, and would produce very little current and very little heat, the whole furnace is ſet under a tall dome. Thus the heated air from the real furnace is confined in this dome, and conſtitutes a high column of very light air, which will therefore riſe with great force up the dome, and eſcape at the top. The dome is therefore the chimney, and would produce a draught or current proportioned to its height. Some are raiſed above an hundred feet. When all the doors of this houſe are ſhut, and thus no ſupply given except through the fire, the current and heat become prodigious. This, however, cannot be done, becauſe the workmen are in this chimney, and muſt have reſpirable air. But notwithſtanding this ſupply by the houſe-doors, the draught of the real furnace is vaſtly increaſed by the dome, and a heat produced ſufficient for the work, and which could not have been produced without the dome.

370 Improvement of Mr Cotterel for melting iron from the ore.

This has been applied with great ingenuity and effect to a furnace for melting iron from the ore, and an iron finery, both without a blaſt. The common blaſt iron furnace is well known. It is a tall cone with the apex undermoſt. The ore and fluxes are thrown into this cone mixed intimately with the fuel till it is full, and the blaſt of moſt powerful bellows is directed into the bottom of this cone through a hole in the ſide. The air is thrown in with ſuch force, that it makes its way through the maſs of matter, kindles the fuel in its paſſage, and fluxes the materials, which then drop down into a receptacle below the blaſt-hole, and thus the paſſage for the air is kept unobſtructed. It was thought impoſſible to produce or maintain this current without bellows; but Mr Cotterel, an ingenious founder, tried the effect of a tall dome placed over the mouth of the furnace, and though it was not half the height of many glaſshouſe domes, it had the deſired effect. Conſiderable difficulties, however, occurred; and he had not ſurmounted them all when he left the neighbourhood of Edinburgh, nor have we heard that he has yet brought the invention to perfection. It is extremely difficult to place the holes below, at which the air is to enter, at ſuch a preciſe height as neither to be choked by the melted matter, nor to leave ore and ſtones below them unmelted; but the invention is very ingenious, and will be of immenſe ſervice if it can be perfected; for in many places iron ore is to be found where water cannot be had for working a blaſt furnace.

371 Currents of air applied to free mines, ſhips, priſons, &c. of noxious air.

The laſt application which we ſhall make of the currents produced by heating the air is to the freeing mines, ſhips, priſons, &c. from the damp and noxious vapours which frequently infeſt them.

As a drift or work is carried on in the mine, let a trunk of dale boards, about 6 or 8 inches ſquare, be laid along the bottom of the drift, communicating with a trunk carried up in the corner of one of the ſhafts. Let the top of this laſt trunk open into the aſh-pit of a ſmall furnace, having a tall chimney. Let fire be kindled in the furnace; and when it is well heated, ſhut the fire-place and aſh-pit doors. There being no other ſupply for the current produced in the chimney of this furnace, the air will flow into it from the trunk, and will bring along with it all the offenſive vapours. This is the moſt effectual method yet found out. In the ſame manner may trunks be conducted into the aſh-pit of a furnace from the cells of a priſon or the wards of an hoſpital.

372 Air neceſſary for the combuſtion of fuel.

In the account which we have been giving of the management of air in furnaces and common fires, we have frequently mentioned the immediate application of air to the burning fuel as neceſſary for its combuſtion. This is a general fact. In order that any inflammable body may be really inflamed, and its combuſtible matter conſumed and aſhes produced, it is not enough that the body be made hot. A piece of charcoal incloſed in a box of iron may be kept red-hot for ever, without waſting its ſubſtance in the ſmalleſt degree. It is farther neceſſary that it be in contact with a particular ſpecies of air, which conſtitutes about $\frac{3}{8}$ths of the air of the atmoſphere, viz. the vital air of Lavoiſier. It was called *empyreal air* by Scheele, who firſt obſerved its indiſpenſable uſe in maintaining fire: and it appears, that, in contributing to the combuſtion of an inflammable body, this air combines with ſome of its ingredients, and becomes fixed air, ſuffering the ſame change as by the breathing of animals. Combuſtion may therefore be conſidered as a ſolution of the inflammable body in air. This doctrine was firſt promulgated by the celebrated Dr Hooke in his *Micrographia*, publiſhed in 1660, and afterwards improved in his treatiſe on Lamps. It is now completely eſtabliſhed, and conſidered as a new diſcovery. It is for this reaſon that in fire-places of all kinds we have directed the conſtruction, ſo as to produce a cloſe application of the air to the fuel. It is quite needleſs at this day to enter into the diſcuſſions which formerly occupied philoſophers about the manner in which the preſſure and elaſticity of the air promoted combuſtion. Many experiments were made in the laſt century by the firſt members of the Royal Society, to diſcover the office of air in combuſtion. It was thought that the flame was extinguiſhed in rare air for want of a preſſure to keep it together; but this did not explain its extinction when the air was not renewed. Theſe experiments are ſtill retained in courſes of experimental philoſophy, as they are injudiciouſly ſtyled; but they give little or no information, nor tend to the illuſtration of any pneumatical doctrine; they are therefore omitted in this place. In ſhort, it is now fully eſtabliſhed, that it is not a mechanical but a chemical phenomenon. We can only inform the chemiſt, that a candle will conſume faſter in the low countries than in the elevated regions of Quito and Gondar, becauſe the air is nearly one half denſer below, and will act proportionally faſter in decompoſing the candle.

373 Curious effects of the air's preſſure.

We ſhall conclude this part of our ſubject with the explanation of a curious phenomenon obſerved in many places. Certain ſprings or fountains are obſerved to have periods of repletion and ſcantineſs, or ſeem to ebb and flow at regular intervals; and ſome of theſe periods are of a complicated nature. Thus a well will have ſeveral returns of high and low water, the difference of which gradually increaſes to a maximum, and then diminiſhes, juſt as we obſerve in the ocean. A very ingenious and probable explanation of this has been given in N° 424. of the Philoſophical Tranſactions, by Mr Atwell, as follows.

Let ABCD (fig. 63.) repreſent a cavern, into which water is brought by the ſubterraneous paſſage OT. Let it have an outlet MNP, of a crooked form, with its higheſt part N conſiderably raiſed above the bottom of the cavern, and thence ſloping downwards into lower ground, and terminating in an open well at P. Let the dimenſions of this canal be ſuch that it will diſcharge much more water than is ſupplied by TO. All this is very natural, and may be very common. The effect of this arrangement will be a remitting ſpring at P: for when the cavern is filled higher than the point N, the canal MNP will act as a ſyphon; and, by the conditions aſſumed, it will diſcharge the water faſter than TO ſupplies it; it will therefore run it dry, and then the ſpring at P will ceaſe to furniſh water. After ſome time the cavern will again be filled up to the height N, and the flow at P will recommence.

If, beſides this ſupply, the well P alſo receive water from a conſtant ſource, we ſhall have a reciprocating ſpring.

The ſituation and dimenſions of this ſyphon canal, and the ſupply of the feeder, may be ſuch, that the efflux at P will be conſtant. If the ſupply increaſe in a certain degree, a reciprocation will be produced at P with very ſhort intervals; if the ſupply diminiſhes conſiderably, we ſhall have another kind of reciprocation with great intervals and great differences of water.

If the cavern has another ſimple outlet R, new varieties will be produced in the ſpring P, and R will afford a curious ſpring. Let the mouth of R, by which the water enters it from the cavern, be lower than N, and let the ſupply of the feeding ſpring be no greater than R can diſcharge, we ſhall have a conſtant ſpring from R, and P will give no water. But ſuppoſe that the main feeder increaſes in winter or in rainy ſeaſons, but not ſo much as will ſupply both P and R, the cavern will fill till the water gets over N, and R will be running all the while; but ſoon after P has begun to flow, and the water in the cavern ſinks below R, the ſtream from R will ſtop. The cavern will be emptied by the ſyphon canal MNP, and then P will ſtop. The cavern will then begin to fill, and when near full R will give a little water, and ſoon after P will run and R ſtop as before, &c.

Deſaguliers ſhows, Vol. II. p. 177, &c. in what manner a prodigious variety of periodical ebbs and flows may be produced by underground canals, which are extremely ſimple and probable.

374 Account of ſome pneumatic engines.

We ſhall conclude this article with the deſcriptions of ſome pneumatical machines or engines which have not been particularly noticed under their names in the former volumes of this work.

Bellows are of moſt extenſive and important uſe; and it will be of ſervice to deſcribe ſuch as are of uncommon conſtruction and great power, fit for the great operations in metallurgy.

It is not the impulſive force of the blaſt that is wanted in moſt caſes, but merely the copious ſupply of air, to produce the rapid combuſtion of inflammable matter; and the ſervice would be better performed in general if this could be done with moderate velocities, and an extended ſurface. What are called air-furnaces, where a conſiderable ſurface of inflammable matter is acted on at once by the current which the mere heat of the expended air has produced, are found more operative in proportion to the air expended than blaſt furnaces animated by bellows; and we doubt not but that the method propoſed by Mr Cotterel (which we have already mentioned) of increaſing this current in a melting furnace by means of a dome, will in time ſuperſede the blaſt furnaces. There is indeed a great impulſive force required in ſome caſes; as for blowing off the ſcoriæ from the ſurface of ſilver or copper in refining furnaces, or for keeping a clear paſſage for the air in the great iron furnace.

In general, however, we cannot procure this abundant ſupply of air any other way than by giving it a great velocity by means of a great preſſure, ſo that the general conſtruction of bellows is pretty much the ſame in all kinds. The air is admitted into a very large cavity, and then expelled from it through a ſmall hole.

Plate CCCCVI.

The furnaces at the mines having been greatly enlarged; it was neceſſary to enlarge the bellows alſo: and the leathern bellows becoming exceedingly expenſive, wooden ones were ſubſtituted in Germany about the beginning of laſt century, and from them became general through Europe. They conſiſt of a wooden box ABCPFE (fig. 74. A), which has its top and two ſides flat or ſtraight, and the end BAE*e* formed into an arched or cylindrical ſurface, of which the line FP at the other end is the axis. This box is open below, and receives within it the ſhallow box KHGNML (fig. B), which exactly fills it. The line FP of the one coincides with FP of the other, and along this line is a ſet of hinges on which the upper box turns as it riſes and ſinks. The lower box is made faſt to a frame fixed in the ground. A pipe OQ proceeds from the end of it, and terminates at the furnace, where it ends in a ſmall pipe called the *tewer* or *tuyere*. This lower box is open above, and has in its bottom two large valves V, V, opening inwards. The conducting pipe is ſometimes furniſhed with a valve opening outwards, to prevent burning coals from being ſucked into the bellows when the upper box is drawn up. The joint along PF is made tight by thin leather nailed along it. The ſides and ends of the fixed box are made to fit the ſides and curved end of the upper box, ſo that this laſt can be raiſed and lowered round the joint FP without ſenſible friction, and yet without ſuffering much air to eſcape: but as this would not be ſufficiently air-tight by reaſon of the ſhrinking and warping of the wood, a farther contrivance is adopted. A ſlender lath of wood, divided into ſeveral joints, and covered on the outer edge with very ſoft leather, is laid along the upper edges of the ſides and ends of the lower box. This lath is ſo broad, that when its inner edge is even with the inſide of the box, its outer edge projects about an inch. It is kept in this poſition by a number of ſteel wires, which are driven into the bottom of the box, and ſtand up touching the ſides, as repreſented in figure D, where *a b c* are the wires, and *e* the lath, projecting over the outſide of the box. By this contrivance the laths are preſſed cloſe to the ſides and curved end of the moveable box, and the ſpring wires yield to all their inequalities. A bar of wood RS is fixed to the upper board, by which it is either raiſed by machinery, to ſink again by its own weight, having an additional load laid on it, or it is forced downward by a crank or wiper of the machinery, and afterwards raiſed.

The operation here is preciſely ſimilar to that of blowing with a chamber-bellows. When the board is lifted up, the air enters by the valves V, V, and is expelled at the pipe OQ by depreſſing the boards. There is therefore no occaſion to inſiſt on this point.

Theſe bellows are made of a very great ſize, AD being 16 feet, AB five feet, and the circular end AE alſo five feet. The riſe, however, is but about 3 or $3\frac{1}{2}$ feet. They expel at each ſtroke about 90 cubic feet of air, and they make about 8 ſtrokes per minute.

Such are the bellows in general uſe on the continent. They have adopted a different form in Britain, which ſeems much preferable. They uſe an iron or wooden cylinder, with a piſton ſliding along it. This may be made with much greater accuracy than the wooden boxes, at leſs expence, if of wood, becauſe it may be of coopers work, held together by hoops; but the great advantage of this form is its being more eaſily made air-tight. The piſton is ſurrounded with a broad ſtrap of thick and ſoft leather, and it has around its edge a deep groove, in which is lodged a quantity of wool. This is called the packing or ſtuffing, and keeps the leather very cloſely applied to the inner ſurface of the cylinder. Iron cylinders may be very neatly bored and ſmoothed, ſo that the piſton, even when very tight, will ſlide along it very ſmoothly. To promote this, a quantity of black lead is ground very fine with water, and a little of this is ſmeared on the inſide of the cylinder from time to time.

The cylinder has a large valve, or ſometimes two, in the bottom, by which the atmoſpheric air enters when the piſton is drawn up. When the piſton is thruſt down, this air is expelled along a pipe of great diameter, which terminates in the furnace with a ſmall orifice.

This is the ſimpleſt form of bellows which can be conceived. It differs in nothing but ſize from the bellows uſed by the rudeſt nations. The Chineſe ſmiths have a bellows very ſimilar, being a ſquare pipe of wood ABCDE (fig. 75.), with a ſquare board G which exactly fits it, moved by the handle FG. At the farther end is the blaſt pipe HK, and on each ſide of it a valve in the end of the ſquare pipe, opening inwards. The piſton is ſufficiently tight for their purpoſes without any leathering.

The piſton of this cylinder bellows is moved by machinery. In ſome blaſt engines the piſton is ſimply raiſed by the machine, and then let go, and it deſcends by its own weight, and compreſſes the air below it to ſuch a degree, that the velocity of efflux becomes conſtant, and the piſton deſcends uniformly: for this purpoſe it muſt be loaded with a proper weight. This produces a very uniform blaſt, except at the very beginning, while the piſton falls ſuddenly and compreſſes the air: but in moſt engines the piſton rod is forced down the cylinder with a determined motion, by means of a beam, crank, or other contrivance. This gives a more unequal blaſt, becauſe the motion of the piſton is neceſſarily ſlow in the beginning and end of the ſtroke, and quicker in the middle.

But in all it is plain that the blaſt muſt be deſultory. It ceaſes while the piſton is riſing; for this reaſon it is uſual to have two cylinders, as it was formerly uſual to have two bellows which worked alternately. Sometimes three or four are uſed, as at the Carron iron works. This makes a blaſt abundantly uniform.

But

Fig. 72.

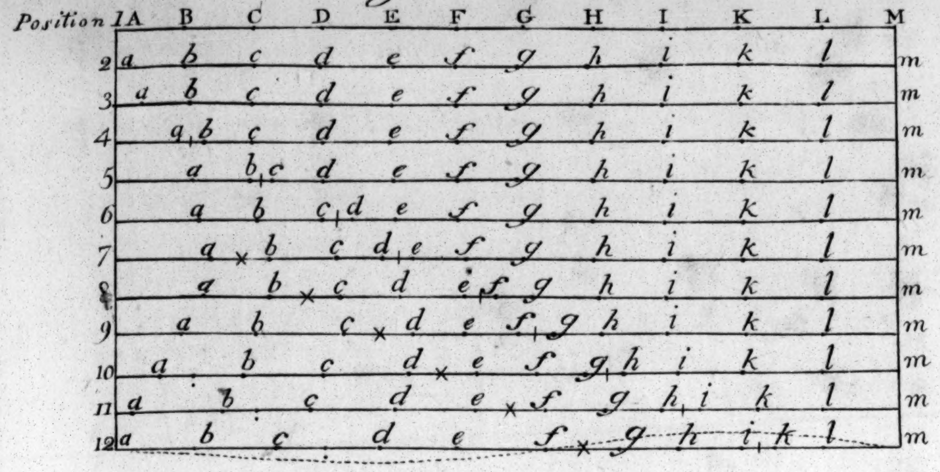

Position 1 A B C D E F G H I K L M
2 a b c d e f g h i k l m
3 a b c d e f g h i k l m
4 a b c d e f g h i k l m
5 a b c d e f g h i k l m
6 a b c d e f g h i k l m
7 a b c d e f g h i k l m
8 a b c d e f g h i k l m
9 a b c d e f g h i k l m
10 a b c d e f g h i k l m
11 a b c d e f g h i k l m
12 a b c d e f g h i k l m

Fig. 73.

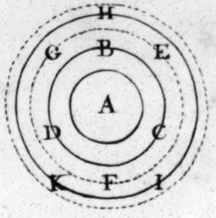
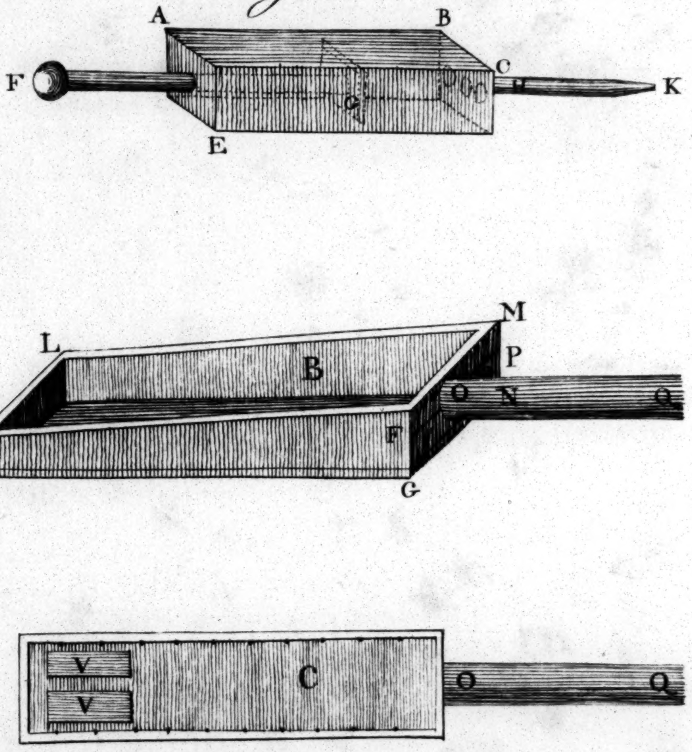

H
G
B
E
A
D
C
K
F
I

Fig. 75.


A
B
F
C
K
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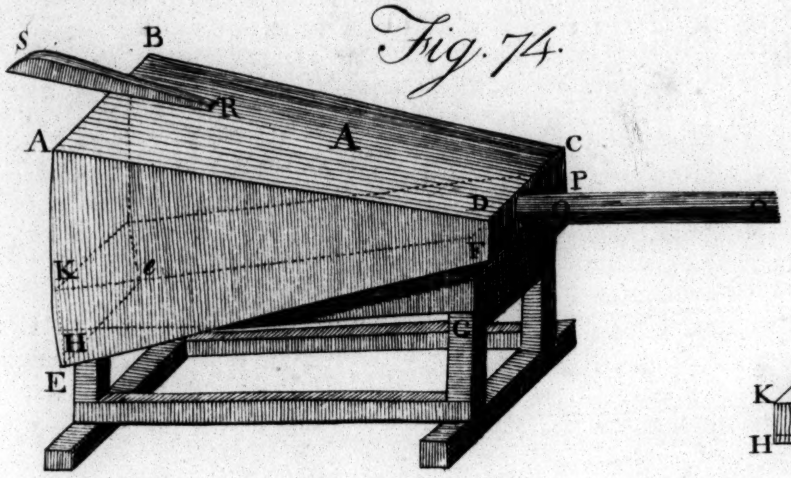
V
C
O
Q

Fig. 74.


S
B
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e
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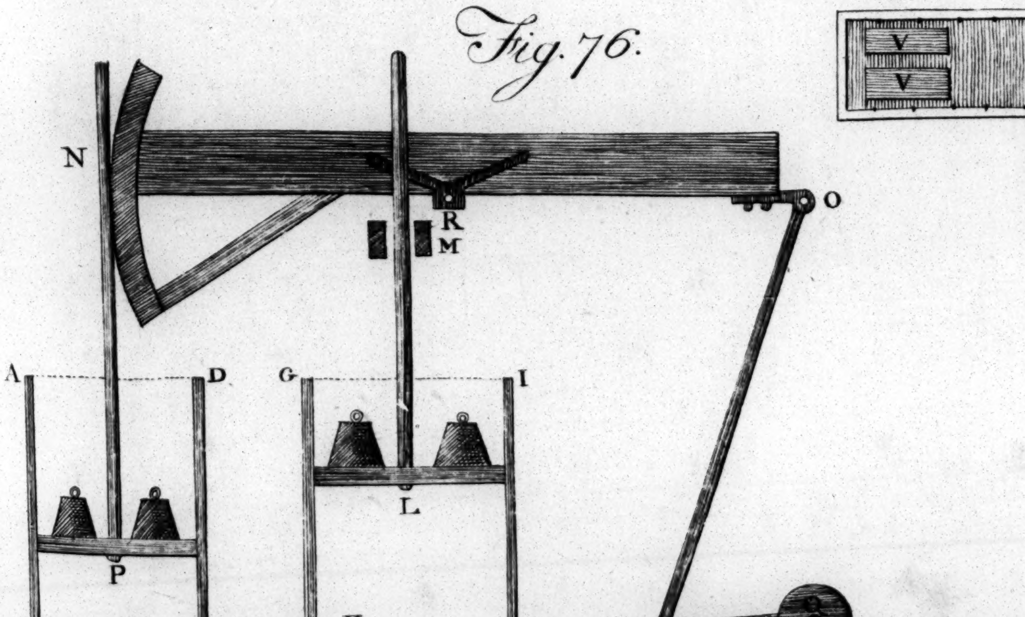
H
E

Fig. 76.


N
R
M
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A
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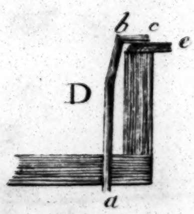
G
I
L
P
E
F
B
C
H
K
P
S
T



BRITISH MUSEUM

But an uniform blaſt may be made with a ſingle cylinder, by making it deliver its air into another cylinder, which has a piſton exactly fitted to its bore, and loaded with a ſufficient weight. The blowing cylinder ABCD (fig. 76.) has its piſton P worked by a rod NP, connected by double chains with the arched head of the working beam NO, moving round a gudgeon at R. The other end O of this beam is connected by the rod OP, with the crank PQ of a wheel machine; or it may be connected with the piſton of a ſteam engine, &c. &c. The blowing cylinder has a valve or valves E in its bottom, opening inwards. There proceeds from it a large pipe CF, which enters the regulating cylinder GHKI, and has a valve at top to prevent the air from getting back into the blowing cylinder. It is evident that the air forced into this cylinder muſt raiſe its piſton L, and that it muſt afterwards deſcend, while the other piſton is riſing. It muſt deſcend uniformly, and make a perfectly equable blaſt.

Plate CCCCVI.

Obſerve, that if the piſton L be at the bottom when the machine begins to work, it will be at the bottom at the end of every ſtroke, if the *tuyere* T emits as much air as the cylinder ABCD furniſhes; nay, it will lie a while at the bottom, for, while it was riſing, air was iſſuing through T. This would make an interrupted blaſt. To prevent this, the orifice T muſt be leſſened; but then there will be a ſurplus of air at the end of each ſtroke, and the piſton L will riſe continually, and at laſt get to the top, and allow air to eſcape. It is juſt poſſible to adjuſt circumſtances, ſo that neither ſhall happen. This is done eaſier by putting a ſtop in the way of the piſton, and putting a valve on the piſton, or on the conducting pipe KST, loaded with a weight a little ſuperior to the intended elaſticity of the air in the cylinder. Therefore, when the piſton is prevented by the ſtop from riſing, the ſnifting valve, as it is called, is forced open, the ſuperfluous air eſcapes, and the blaſt preſerves its uniformity.

It may be of uſe to give the dimenſions of a machine of this kind, which has worked for ſome years at a very great furnace, and given ſatisfaction.

The diameter of the blowing cylinder is 5 feet, and the length of the ſtroke is 6. Its piſton is loaded with $3\frac{1}{2}$ tons. It is worked by a ſteam-engine whoſe cylinder is 3 feet 4 inches wide, with a ſix feet ſtroke. The regulating cylinder is 8 feet wide, and its piſton is loaded with $8\frac{1}{4}$ tons, making about 2,63 pounds on the ſquare inch; and it is very nearly in equilibrio with the load on the piſton of the blowing cylinder. The conducting pipe KST is 12 inches in diameter, and the orifice of the tuyere was $1\frac{5}{8}$ inches when the engine was erected, but it has gradually enlarged by reaſon of the intenſe heat to which it is expoſed. The ſnifting valve is loaded with 3 pounds on the ſquare inch.

When the engine worked briſkly, it made 18 ſtrokes per minute, and there was always much air diſcharged by the ſnifting valve. When the engine made 15 ſtrokes per minute, the ſnifting valve opened but ſeldom, ſo that things were nearly adjuſted to this ſupply. Each ſtroke of the blowing cylinders ſent in 118 cubic feet of common air. The ordinary preſſure of the air being ſuppoſed $14\frac{3}{4}$ pounds on an inch, the denſity of the air in the regulating cylinder muſt be $\frac{14,76+2.63}{14,75}$, $=1,1783$, the natural denſity being 1.

This machine gives an opportunity of comparing the expence of air with the theory. It muſt (at the rate of 15 ſtrokes) expel 30 cubic feet of air in a ſecond through a hole of $1\frac{5}{8}$ inches in diameter. This gives a velocity of near 2000 feet per ſecond, and of more than 1600 feet for the condenſed air. This is vaſtly greater than the theory can give, or is indeed poſſible; for air does not ruſh into a void with ſo great velocity. It ſhows with great evidence, that a vaſt quantity of air muſt eſcape round the two piſtons. Their united circumferences amount to about 40 feet, and they move in a dry cylinder. It is impoſſible to prevent a very great loſs. Accordingly, a candle held near the edge of the piſton L has its flame very much diſturbed. This caſe, therefore, gives no hold for a calculation; and it ſuggeſts the propriety of attempting to diminiſh this great waſte.

This has been very ingeniouſly done (in part at leaſt) at ſome other furnaces. At Omoah foundery, near Glaſgow, the blowing cylinder (alſo worked by a ſteam engine) delivers its air into a cheſt without a bottom, which is immerſed in a large ciſtern of water, and ſupported at a ſmall height from the bottom of the ciſtern, and has a pipe from its top leading to the tuyere. The water ſtands about five feet above the lower brim of the regulating air-cheſt, and by its preſſure gives the moſt perfect uniformity of blaſt, without allowing a particle of air to get off by any other paſſage beſides the tuyere. This is a very effectual regulator, and muſt produce a great ſaving of power, becauſe a ſmaller blowing cylinder will thus ſupply the blaſt. We have not learned the dimenſions and performance of this engine. We muſt obſerve, that the loſs round the piſton of the blowing cylinder remains undiminiſhed.

A blowing machine was erected many years ago at Chaſtillon in France on a principle conſiderably different, and which muſt be perfectly air-tight throughout. Two cylinders A, B (fig. 77.), loaded with great weights, were ſuſpended at the ends of the lever CD, moving round the gudgeon E. From the top F, G of each there was a large flexible pipe which united in H, from whence a pipe KT led to the tuyere T. There were valves at F and G opening outwards, or into the flexible pipes; and other valves L, M, adjoining to them in the top of each cylinder, opening inwards, but kept ſhut by a ſlight ſpring. Motion was given to the lever by a machine. The operation of this blowing machine is evident. When the cylinder A was pulled down, or allowed to deſcend, the water, entering at its bottom, compreſſed the air, and forced it along the paſſage FHKT. In the mean time, the cylinder B was riſing, and the air entered by the valve M. We ſee that the blaſt will be very unequal, increaſing as the cylinder is immerſed deeper. It is needleſs to deſcribe this machine more particularly, becauſe we ſhall give an account of one which we think perfect in its kind, and which leaves hardly any thing to be deſired in a machine of this ſort. It was invented by Mr John Laurie, land-ſurveyor in Edinburgh, about 15 years ago, and improved in ſome reſpects ſince his death by an ingenious perſon of that city.

Plate CCCCVII.

ABCD (fig. 78.) is an iron cylinder, truly bored within, and evaſated a-top like a cup. EFGH is another, truly turned both without and within, and a ſmall matter leſs than the inner diameter of the firſt cylinder.

This cylinder is cloſe above, and hangs from the end of a lever moved by a machine. It is alſo loaded with weights at N. KILM is a third cylinder, whoſe outſide diameter is ſomewhat leſs than the inſide diameter of the ſecond. This inner cylinder is fixed to the ſame bottom with the outer cylinder. The middle cylinder is looſe, and can move up and down between the outer and inner cylinders without rubbing on either of them. The inner cylinder is perforated from top to bottom by three pipes OQ, SV, PR. The pipes OQ, PR have valves at their upper ends O, P, and communicate with the external air below. The pipe SV has a horizontal part VW, which again turns upwards, and has a valve at top X. This upright part WX is in the middle of a ciſtern of water *f h k g*. Into this ciſtern is fixed an air-cheſt *a*YZ*b*, open below, and having at top a pipe *c d e* terminating in the tuyere at the furnace.

When the machine is at reſt, the valves X, O, P, are ſhut by their own weights, and the air-cheſt is full of water. When things are in this ſtate, the middle cylinder EFGH is drawn up by the machinery till its lower brims F and G are equal with the top RM of the inner cylinder. Now pour in water or oil between the outer and middle cylinders: it will run down and fill the ſpace between the outer and inner cylinders. Let it come to the top of the inner cylinder.

Now let the loaded middle cylinder deſcend. It cannot do this without compreſſing the air which is between its top and the top of the inner cylinder. This air being compreſſed will cauſe the water to deſcend between the inner and middle cylinders, and riſe between the middle and outer cylinders, ſpreading into the cup; and as the middle cylinder advances downwards, the water will deſcend farther within it and riſe farther without it. When it has got ſo far down, and the air has been ſo much compreſſed, that the difference between the ſurface of the water on the inſide and outſide of this cylinder is greater than the depth of water between X and the ſurface of the water *f g*, air will go out by the pipe SVW, and will lodge in the air cheſt, and will remain there if *c* be ſhut, which we ſhall ſuppoſe for the preſent. Puſhing down the middle cylinder till the partition touch the top of the inner cylinder, all the air which was formerly between them will be forced into the air-cheſt, and will drive out water from it. Draw up the middle cylinder, and the external air will open the valves O, P, and again fill the ſpace between the middle and inner cylinders; for the valve X will ſhut, and prevent the regreſs of the condenſed air. By puſhing down the middle cylinder a ſecond time, more air will be forced into the air-cheſt, and it will at laſt eſcape by getting out between its brims Y, Z and the bottom of the ciſtern; or if we open the paſſage *c*, it will paſs along the conduit *c d e* to the tuyere, and form a blaſt.

The operation of this machine is ſimilar to Mr Haſkins's quickſilver pump deſcribed by Deſaguliers at the end of the ſecond volume of his Experimental Philoſophy. The force which condenſes the air is the load on the middle cylinder. The uſe of the water between the inner and outer cylinders is to prevent this air from eſcaping; and the inner cylinder thus performs the office of a piſton, having no friction. It is neceſſary that the length of the outer and middle cylinders be greater than the depth of the regulator-ciſtern, that there may be a ſufficient height for the water to riſe between the middle and outer cylinders, to balance the compreſſed air, and oblige it to go into the air-cheſt. A large blaſt-furnace will require the regulator-ciſtern five feet deep, and the cylinders about ſix or ſeven feet long.

It is in fact a pump without friction, and is perfectly air-tight. The quickneſs of its operation depends on the ſmall ſpace between the middle cylinder and the two others; and this is the only uſe of theſe two. Without theſe it would be ſimilar to the engine at Chaſtillon, and operate more unequally and ſlowly. Its only imperfection is, that if the cylinder begin its motion of aſcent or deſcent rapidly, as it will do when worked by a ſteam-engine, there will be ſome danger of water daſhing over the top of the inner cylinder and getting into the pipe SV; but ſhould this happen, an iſſue can eaſily be contrived for it at V, covered with a loaded valve *v*. This will never happen if the cylinder is moved by a crank.

One blowing cylinder only is repreſented here, but two may be uſed.

We do not heſitate in recommending this form of bellows as the moſt perfect of any, and fit for all uſes where ſtanding bellows are required. They will be cheaper than any other ſort for common purpoſes. For a common ſmith's forge they may be made with ſquare wooden boxes inſtead of cylinders. They are alſo eaſily repaired. They are perfectly tight; and they may be made with a blaſt almoſt perfectly uniform, by making the ciſtern in which the air-cheſt ſtands of conſiderable dimenſions. When this is the caſe, the height of water, which regulates the blaſt, will vary very little.

This may ſuffice for an account of blaſt machines. The leading parts of their conſtruction have been deſcribed as far only as was neceſſary for underſtanding their operation, and enabling an engineer to erect them in the moſt commodious manner. Views of complete machines might have amuſed, but they would not have added to our reader's information.

But the account is imperfect unleſs we ſhow how their parts may be ſo proportioned that they ſhall perform what is expected from them. The engineer ſhould know what ſize of bellows, and what load on the board or piſton, and what ſize of tuyere, will give the blaſt which the ſervice requires, and what force muſt be employed to give them the neceſſary degree of motion. We ſhall accompliſh theſe purpoſes by conſidering the efflux of the compreſſed air through the tuyere. The propoſitions formerly delivered will enable us to aſcertain this.

That we may proportion every thing to the power employed, we muſt recollect, that it the piſton of a cylinder employed for expelling air be preſſed down with any force *p*, it muſt be conſidered as ſuperadded to the atmoſpheric preſſure P on the ſame piſton, in order that we may compare the velocity *v* of efflux with the known velocity V with which air ruſhes into a void. By what has been formerly delivered, it appears that this velocity $v = V \times \sqrt{\frac{p}{P \times p}}$, where P is the preſſure of the atmoſphere on the piſton, and *p* the additional load laid on it. This velocity is expreſſed in feet *per* ſecond; and, when multiplied by the area of the orifice (alſo expreſſed in ſquare feet), it will give us the cubical feet of condenſed air expelled in a ſecond: but the bellows are always to be filled again with common air, and therefore we want to know the quantity of common air which will be expelled; for it is this which determines the number of ſtrokes which muſt be made in a minute, in order that the proper ſupply may be obtained. Therefore recollect that the quantity expelled from a given orifice with a given velocity, is in the proportion of the denſity; and that when D is the denſity of common air produced by the preſſure P, the denſity *d* produced by the preſſure $P+p$, is $D\times\frac{P+p}{P}$; or it D be made 1, we have $d=\frac{P+p}{P}$.

Therefore, calling the area of the orifice expreſſed in ſquare feet O, and the quantity of common air, or the cubic feet expelled in a ſecond Q, we have $Q=V\times O\times\sqrt{\frac{p}{P+p}}\times\frac{P+p}{P}$.

It will be ſufficiently exact for all practical purpoſes to ſuppoſe P to be 15 pounds on every ſquare inch of the piſton; and *p* is then conveniently expreſſed by the pounds of additional load on every ſquare inch: we may alſo take $V=1332$ feet.

As the orifice through which the air is expelled is generally very ſmall, never exceeding three inches in diameter, it will be more convenient to expreſs it in ſquare inches; which being the $\frac{1}{144}$ of a ſquare foot, we ſhall have the cubic feet of common air expelled in a ſecond. or $Q=\frac{1332}{144}O\sqrt{\frac{p}{P+p}}\times\frac{P+p}{P},=O\times 9{,}25\times\sqrt{\frac{p}{P+p}}\times\frac{P+p}{P}$; and this ſeems to be as ſimple an expreſſion as we can obtain.

This will perhaps be illuſtrated by taking an example in numbers. Let the area of the piſton be four ſquare feet, and the area of the round hole through which the air is expelled be two inches, its diameter being 1,6, and let the load on the piſton be 1728 pounds: this is three pounds on every ſquare inch. We have $P=15$, $p=3$, $P+p=18$, and $O=2$; therefore we will have $Q=2\times 9{,}25\times\sqrt{\frac{3}{18}}\times\frac{18}{15},=9{,}053$ cubic feet of common air expelled in a ſecond. This will however be diminiſhed at leaſt one third by the contraction of the jet; and therefore the ſupply will not exceed ſix cubic feet *per* ſecond. Suppoſing therefore that this blowing machine is a cylinder or priſm of this dimenſion in its ſection, the piſton ſo loaded would (after having compreſſed the air) deſcend about 15 inches in a ſecond: It would firſt ſink $\frac{1}{6}$ of the whole length of the cylinder pretty ſuddenly, till it had reduced the air to the denſity $\frac{18}{15}$, and would then deſcend uniformly at the above rate, expelling ſix cubic feet of common air in a ſecond.

The computation is made much in the ſame way for bellows of the common form, with this additional circumſtance, that as the loaded board moves round a hinge at one end, the preſſure of the load muſt be calculated accordingly. The computation, however, becomes a little intricate, when the form of the loaded board is not rectangular; it is almoſt uſeleſs when the bellows have flexible ſides, either like ſmith's bellows or like organ bellows, becauſe the change of figure during their motion makes continual variation on the compreſſing powers. It is therefore chiefly with reſpect to the great wooden bellows, of which the upper board ſlides down between the ſides, that the above calculation is of ſervice.

The propriety however of this piece of information is evident: we do not know preciſely the quantity of air neceſſary for animating a furnace; but this calculation tells us what force muſt be employed for expelling the air that may be thought neceſſary. If we have fixed on the ſtrength of the blaſt, and the diameter of the cylinder, we learn the weight with which the piſton muſt be loaded; the length of the cylinder determines its capacity, the above calculation tells the expence *per* ſecond; hence we have the time of the piſton's coming to the bottom. This gives us the number of ſtrokes *per* minute: the load muſt be lifted up by the machine this number of times, making the time of aſcent preciſely equal to that of deſcent; otherwiſe the machine will either catch and ſtop the deſcent of the piſton or allow it to lie inactive for a while of each ſtroke. Theſe circumſtances determine the labour to be performed by the machine, and it muſt be conſtructed accordingly. Thus the engineer will not be affronted by its failure, nor will he expend needleſs power and coſt.

In machines which force the piſton or bellows-board with a certain determined motion, different from what ariſes from their own weight, the computation is extremely intricate. When a piſton moves by a crank, its motion at the beginning and end of each ſtroke is ſlow, and the compreſſion and efflux is continually changing: we can however approximate to a ſtatement of the force required.

Every time the piſton is drawn up, a certain ſpace of the cylinder is filled again with air of the common denſity; and this is expelled during the deſcent of the piſton. A certain number of cubic feet of common air is therefore expelled with a velocity which perhaps continually varies; but there is a medium velocity with which it might have been uniformly expelled, and a preſſure correſponding to this velocity. To find this, divide the area of the piſton by the area of the blaſt-hole (or rather by this area multiplied by 0,613, in order to take in the effect of the contracted jet), and multiply the length of the ſtroke performed in a ſecond by the quotient ariſing from this diviſion; the product is the medium velocity of the air of the (natural denſity). Then find by calculation the height through which a heavy body muſt fall in order to acquire this velocity; this is the height of a column of homogeneous air which would expel it with this velocity. The weight of this column is the leaſt force that can be exerted by the engine: but this force is too ſmall to overcome the reſiſtance in the middle of the ſtroke, and it is too great even for the end of the ſtroke, and much too great for the beginning of it. But if the machine is turned by a very heavy water-wheel, this will act as a regulator, accumulating in itſelf the ſuperfluous force during the too favourable poſitions of the crank, and exerting it by its *vis inſita* during the time of greateſt effort. A force not greatly exceeding the weight of this column of air will therefore ſuffice. On the other hand, if the ſtrength of the blaſt be determined, which is the general ſtate of the problem, this determines the degree of condenſation of the air and the load on the ſquare inch of the piſton, or the mean force which the machine muſt exert on it. A table, which will be given preſently, determines the cubic feet of common air expelled in a ſecond, correſponding to this load. This combined with the propoſed dimenſions of the cylinder, will give the deſcent of the piſton or the length of the ſtroke.

Theſe general obſervations apply to all forms of bellows; and without a knowledge of them no perſon can erect a machine for working them without total uncertainty or ſervile imitation. In order, therefore, that they may be uſeful to ſuch as are not accuſtomed to the management of even theſe ſimple formulæ, we inſert the following ſhort table of the velocity and quantity of air diſcharged from a cylinder whoſe piſton is loaded with the pounds contained in the firſt column on every ſquare inch. The ſecond column contains the velocity with which the *condenſed air* ruſhes out through any *ſmall* hole; and the third column is the cubic feet diſcharged from a hole whoſe area is a ſquare inch; column fourth contains the mean velocity of air of the common denſity; and column fifth is the cubic feet of common air diſcharged; the ſixth column is the height in inches at which the force of the blaſt would ſupport a column of water if a pipe were inſerted into the ſide of the cylinder. This is an extremely proper addition to ſuch machines, ſhowing at all times the power of the machines, and teaching us what intenſity of blaſt is employed for different purpoſes. The table is computed from the ſuppoſition that the ordinary preſſure of the air is 15 pounds on a ſquare inch. This is ſomewhat too great, and therefore the velocities are a little too ſmall; but the quantities diſcharged will be found about ⅓ too great (without affecting the velocities) on account of the convergency of the ſtream.

I	II	III	IV	V	VI
½	239	1,66	247	1,72	14
1	333	2,31	355	2,47	27
1½	404	2,79	437	3,05	40
2	457	3,17	518	3,60	54
2½	500	3,48	584	4,2	68
3	544	3,76	653	4,53	82
3½	582	4,03	715	4,98	95
4	611	4,24	774	5,38	109
4½	642	4,46	822	5,75	122
5	666	4,67	888	6,17	136
5½	693	4,84	950	6,49	150
6	711	5,06	997	6,92	163

This table extends far beyond the limits of ordinary uſe, very few blaſt-furnaces having a force exceeding 60 inches of water.

We ſhall conclude this account of blowing machines with a deſcription of a ſmall one for a blow pipe. Fig. 79. ABCD, is a veſſel containing water, about two feet deep. EFGH is the air-box of the blower open below, and having a pipe ILK riſing up from it to a convenient height; an arm ON which graſps this pipe carries the lamp N; the blow-pipe LM comes from the top of the upright pipe. PKQ is the feeding pipe reaching near to the bottom of the veſſel.

Plate CCCCVII.

Water being poured into the veſſel below, and its cover being put on, which fits the upright pipe, and touches two ſtuds *a*, *a*, projecting from it, blow in a quantity of air by the feeding pipe PQ; this expels the water from the air-box, and occaſions a preſſure which produces the blaſt through the blow-pipe M.

In nº 54. of this article, we mentioned an application which has been made of Hero's fountain, at Chemnitz in Hungary, for raiſing water from the bottom of a mine. We ſhall now give an account of this very ingenious contrivance.

In fig. 80. B repreſents the ſource of water elevated above the mouth of the pit 136 feet. From this there is laid a pipe B*b*CD four inches diameter. This pipe enters the top of a copper cylinder *b c d e*, 8½ feet high, five feet diameter, and two inches thick, and it reaches to within four inches of the bottom; it has a cock at C. This cylinder has a cock at F, and a very large one at E. From the top *b c* proceeds a pipe GHH two inches in diameter, which goes down the pit 96 feet, and is inſerted into the top of another braſs cylinder *f g h i*, which is 6½ feet high, four feet diameter, and two inches thick, containing 83 cubic feet, which is very nearly one half of the capacity of the other, viz. of 170 cubic feet. There is another pipe NI of four inches diameter, which riſes from within four inches of the bottom of this lower cylinder, is ſoldered into its top, and riſes to the trough NO, which carries off the water from the mouth of the pit. This lower cylinder communicates at the bottom with the water L which collects in the drains of the mine. A large cock K ſerves to admit or exclude this water; another cock M, at the top of this cylinder, communicates with the external air.

Now ſuppoſe the cock C ſhut, and all the reſt open; the upper cylinder will contain air, and the lower cylinder will be filled with water, becauſe it is ſunk ſo deep that its top is below the uſual ſurface of the mine-waters. Now ſhut the cocks F, E, M, K, and open the cock C. The water of the ſource B muſt run in by the orifice D, and riſe in the upper cylinder, compreſſing the air above it and along the pipe GHH, and thus acting on the ſurface of the water in the lower cylinder. It will therefore cauſe it to riſe gradually in the pipe IN, where it will always be of ſuch a height that its weight balances the elaſticity of the compreſſed air. Suppoſe no iſſue given to the air from the upper cylinder, it would be compreſſed into ⅕th of its bulk by the column of 136 feet high; for a column of 34 feet nearly balances the ordinary elaſticity of the air. Therefore, when there is an iſſue given to it through the pipe GHH, it will drive the compreſſed air along this pipe, and it will expel water from the lower cylinder. When the upper cylinder is full of water, there will be 34 cubic feet of water expelled from the lower cylinder. If the pipe IN had been more than 136 feet long, the water would have riſen 136 feet, being then in equilibrio with the water in the feeding pipe B*b*CD (as was ſhown in nº 52), by the intervention of the elaſtic air; but no more water would have been expelled from the lower cylinder than what fills this pipe. But the pipe being only 96 feet high, the water will be thrown out at N with a very great velocity. If it were not for the great obſtructions which water and air muſt meet with in their paſſage along pipes, it would iſſue at N with a velocity of more than 50 feet per ſecond. It iſſues much more ſlowly, and at laſt the upper cylinder is full of water, and the water would enter the pipe GH and enter the lower cylinder, and without diſplacing the air in it, would riſe through the diſcharging pipe IN, and run off to waſte. To prevent this there hangs in the pipe HG a cork ball or double cone, by a braſs wire which is guided by holes in two croſs pieces in the pipe HG. When the upper cylinder is filled with water, this cork plugs up the orifice G, and no water is waſted: the influx at D now ſtops. But the lower cylinder contains compreſſed air, which would balance water in a diſcharging pipe 136 feet high, whereas IN is only 96. Therefore the water will continue to flow at N till the air has ſo far expanded as to balance only 96 feet of water, that is, till it occupies $\frac{1}{4}$ of its ordinary bulk, that is, $\frac{1}{4}$ of the capacity of the upper cylinder, or 42$\frac{1}{2}$ cubic feet. Therefore 42$\frac{1}{2}$ cubic feet will be expelled, and the efflux at N will ceaſe; and the lower cylinder is about $\frac{1}{2}$ full of water. When the attending workman obſerves this, he ſhuts the cock C. He might have done this before, had he known when the orifice G was ſtopped; but no loſs enſues from the delay. At the ſame time the attendant opens the cock E, the water iſſues with great violence, being preſſed by the condenſed air from the lower cylinder. It therefore iſſues with the ſum of its own weight and of this compreſſion. Theſe gradually decreaſe together, by the efflux of the water and the expanſion of the air; but this efflux ſtops before all the water has flowed out; for there is 42$\frac{1}{2}$ feet of the lower cylinder occupied by air. This quantity of water remains, therefore, in the upper cylinder nearly: the workman knows this, becauſe the diſcharged water is received firſt of all into a veſſel containing $\frac{3}{4}$ of the capacity of the upper cylinder. Whenever this is filled, the attendant opens the cock K by a long rod which goes down the ſhaft; this allows the water of the mine to fill the lower cylinder, allows the air to get into the upper cylinder, and this allows the remaining water to run out of it.

And thus every thing is brought into its firſt condition; and when the attendant ſees no more water come out at E, he ſhuts the cocks E and M, and opens the cock C, and the operation is repeated.

There is a very ſurpriſing appearance in the working of this engine. When the efflux at N has ſtopped, if the cock F be opened, the water and air ruſh out together with prodigious violence, and the drops of water are changed into hail or lumps of ice. It is a ſight uſually ſhown to ſtrangers, who are deſired to hold their hats to receive the blaſt of air: the ice comes out with ſuch violence as frequently to pierce the hat like a piſtol bullet. This rapid congelation is a remarkable inſtance of the general fact, that air by ſuddenly expanding, generates cold, its capacity for heat being increaſed. Thus the peaſant cools his broth by blowing over the ſpoon, even from warm lungs: a ſtream of air from a pipe is always cooling.

The above account of the procedure in working this engine ſhows that the efflux both at N and E becomes very ſlow near the end. It is found convenient therefore not to wait for the complete diſcharges, but to turn the cocks when about 30 cubic feet of water have been diſcharged at N: more work is done in this way. A gentleman of great accuracy and knowledge of theſe ſubjects took the trouble, at our deſire, of noticing particularly the performance of the machine. He obſerved that each ſtroke, as it may be called, took up about three minutes and $\frac{1}{8}$; and that 32 cubic feet of water were diſcharged at N, and 66 were expended at E. The expence therefore is 66 feet of water falling 136 feet, and the performance is 32 raiſed 96, and they are in the proportion of 66 × 136 to 32 × 96, or of 1 to 0,3422, or nearly as 3 to 1. This is ſuperior to the performance of the moſt perfect underſhot mill, even when all friction and irregular obſtructions are neglected; and is not much inferior to any overſhot pump-mill that has yet been erected. When we reflect on the great obſtructions which water meets with in its paſſage through long pipes, we may be aſſured that, by doubling the ſize of the feeder and diſcharger, the performance of the machine will be greatly improved; we do not heſitate to ſay, that it would be increaſed $\frac{1}{3}$: it is true that it will expend more water; but this will not be nearly in the ſame proportion; for moſt of the deficiency of the machine ariſes from the needleſs velocity of the firſt efflux at N. The diſcharging pipe ought to be 110 feet high, and not give ſenſibly leſs water.

Then it muſt be conſidered how inferior in original expence this ſimple machine muſt be to a mill of any kind which would raiſe 10 cubic feet 96 feet high in a minute, and how ſmall the repairs on it need be, when compared with a mill.

And, laſtly, let it be noticed, that ſuch a machine can be uſed where no mill whatever can be put in motion. A ſmall ſtream of water, which would not move any kind of wheel, will here raiſe $\frac{1}{3}$ of its own quantity to the ſame height; working as faſt as it is ſupplied.

For all theſe reaſons, we think that the Hungarian machine eminently deſerves the attention of mathematicians and engineers, to bring it to its utmoſt perfection, and into general uſe. There are ſituations where this kind of machine may be very uſeful. Thus, where the tide riſes 17 feet, it may be uſed for compreſſing air to $\frac{7}{8}$ of its bulk; and a pipe leading from a very large veſſel inverted in it, may be uſed for raiſing the water from a veſſel of $\frac{1}{8}$ of its capacity 17 feet high; or if this veſſel has only $\frac{1}{16}$ of the capacity of the large one ſet in the tide-way, two pipes may be led from it; one into the ſmall veſſel, and the other into an equal veſſel 16 feet higher, which receives the water from the firſt. Thus $\frac{1}{16}$ of the water may be raiſed 34 feet, and a ſmaller quantity to a ſtill greater height; and this with a kind of power that can hardly be applied in any other way. Machines of this kind are deſcribed by Schottus, Sturmius, Leupold, and other old writers; and they ſhould not be forgotten, becauſe opportunities may offer of making them highly uſeful. A gentleman's houſe in the country may thus be ſupplied with water by a machine that will coſt little, and hardly go out of repair.

The laſt pneumatical engine which we ſhall ſpeak of at preſent is the common fanners, uſed for winnowing grain, and for drawing air out of a room: and we have but few obſervations to make on them.

The wings of the fanners are incloſed in a cylinder or drum, whoſe circular ſides have a large opening BDE (fig. 81.) round the centre to admit the air. By turning the wings rapidly round, the air is hurried round along with them, and thus acquires a centrifugal tendency, by which it preſſes ſtrongly on the outer rim of the drum: Plate CCCCVII.

Pneumatic Engines.

this is gradually detached from the circle as at KI, and terminated in a trunk IHGF, which goes off in a tangential direction: the air therefore is driven along this paſſage.

If the wings were diſpoſed in planes paſſing through the axis C, the compreſſion of the air by their anterior ſurface would give it ſome tendency to eſcape in every direction, and would obſtruct in ſome degree the arrival of more air through the ſide holes. They are therefore reclined a little backward, as repreſented in the figure. It may be ſhown that their beſt form would be that of a hyperbolic ſpiral *abc*; but the ſtraight form approaches ſufficiently near to the moſt perfect ſhape.

Much labour is loſt, however, in carrying the air round thoſe parts of the drum where it cannot eſcape. The fanners would either draw or diſcharge almoſt twice as much air if an opening were made all round one ſide. This could be gradually contracted (where required for winnowing) by a ſurrounding cone, and thus directed againſt the falling grain: this has been verified by actual trial. When uſed for drawing air out of a room for ventilation, it would be much better to remove the outer ſide of the drum entirely, and let the air fly freely off on all ſides; but the flat ſides are neceſſary, in order to prevent the air from arriving at the fanners any other way but through the central holes, to which trunks ſhould be fitted leading to the apartment which is to be ventilated.

Preumatoſis || Pococke.

PNEUMATOSIS. See Medicine, n° 336.

PNEUMONIA. See Medicine, n° 183.

PNEUMONICS, in pharmacy, medicines proper in diſeaſes of the lungs, in which reſpiration is affected.

PO, a large and celebrated river of Italy, which has its ſource at mount Viſo in Piedmont, and on the confines of Dauphiny. It runs through Piedmont, Montſerrat, the Milaneſe, and duchy of Mantua; from thence it runs to the borders of the Parmezan, and a part of the Modeneſe; and having entered the Ferareſe, it begins to divide at Ficheruolo, and proceeds to diſcharge itſelf into the Gulph of Venice by four principal mouths. As it paſſes along, it receives ſeveral rivers, and often overflows its banks, doing a great deal of miſchief: the reaſon of which is, that moſt of thoſe rivers deſcend from the Alps, and are increaſed by the melting of the ſnow.

POA, meadow-grass: A genus of the digynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the fourth order, *Gramina*. The calyx is bivalved and multiflorous; the ſpicula or partial ſpike is ovate, with the valvules ſcarious and a little ſharp, or thin on the margin. There are 20 ſpecies; moſt of them graſſes, and very agreeable food for cattle; for one ſpecies, which grows in marſhes, the cattle will frequently go ſo deep as to endanger their lives. This is called the *aquatica*, or *water reed-graſs*. It is the largeſt of the Britiſh graſſes, growing to the height of five or ſix feet. The leaves are ſmooth, and half an inch wide or more. The panicle is eight or ten inches long, greatly branched, and decked with numerous ſpicula: theſe are of a reddiſh brown colour intermixed with green, of a compreſſed lanceolate form, imbricated with about ſix flowers for the moſt part, but varying from five to ten.

POCHETTI. See Barbatelli.

POCOCKE (Dr Edward), one of the moſt learned men in the oriental tongues in Europe, was the eldeſt ſon of the Rev. Edward Pococke; and was born at Oxford in 1604, where he was alſo bred. In 1628 he was admitted probationer-fellow of his college, and about the ſame time had prepared an edition of the Second Epiſtle of St Peter, the Second and Third of St John, and that of St Jude, in Syriac and Greek, with a Latin Tranſlation and Notes. In 1629 he was ordained prieſt, and appointed chaplain to the Engliſh merchants at Aleppo, where he continued five or ſix years; in which time he diſtinguiſhed himſelf by his fortitude and zeal while the plague raged there. At length returning to England, he was in 1636 appointed reader of the Arabic lectures founded by Archbiſhop Laud. Three years after he went to Conſtantinople, where he proſecuted his ſtudies of the eaſtern tongues, and procured many valuable manuſcripts. After near four years ſtay in that city, he embarked in 1640; and taking Paris in his way, viſited Gabriel Sionita the famous Maronite, and Hugo Grotius. In 1643 he was preſented to the rectory of Childrey in Berks; and about three years after married the daughter of Thomas Burdett, Eſq. About the middle of 1647 he obtained the reſtitution of the ſalary of his Arabic lecture, which had been detained from him about three years. In 1648 king Charles I. who was then priſoner in the iſle of Wight, nominated Mr Pococke to the profeſſorſhip of Hebrew, and the canonry of Chriſt-church annexed to it; but in 1650 he was ejected from his canonry for refuſing to take the engagement, and ſoon after a vote paſſed for depriving him of his Hebrew and Arabic lectures; but ſeveral governors of houſes, &c. preſenting a petition in his favour, he was ſuffered to enjoy both theſe places. He had ſome years before publiſhed his *Specimen Hiſtoriæ Arabum*; and now appeared his *Porta Moſis*: and ſoon after the Engliſh Polyglot edition of the Bible, to which he had largely contributed, and alſo Eutychius's Annals, with a Latin verſion. At the Reſtoration, he was reſtored to the canonry of Chriſt-church, and alſo received the degree of doctor of divinity. He then publiſhed his Arabic verſion of Grotius's Treatiſe of the Truth of the Chriſtian Religion; and an Arabic poem intitled *Lamiato'l Ajam*, with a Latin tranſlation and notes. Soon after he publiſhed Gregory Abul Pharajius's *Hiſtoria Dynaſtiarum*. In 1674 he publiſhed an Arabic verſion of the chief parts of the Liturgy of the Church of England; and a few years after his Commentary on the Prophecies of Micah, Malachi, Hoſea, and Joel. This great man died in 1691, after having been for many years confeſſedly the firſt perſon in Europe for eaſtern learning; and was no leſs worthy of admiration for his uncommon modeſty and humility, and all the virtues that can adorn a Chriſtian. His theological works were republiſhed at London in 1740, in two volumes in folio.

Pococke, Podagra.

PODAGRA, or the Gout. See Medicine, n° 221.

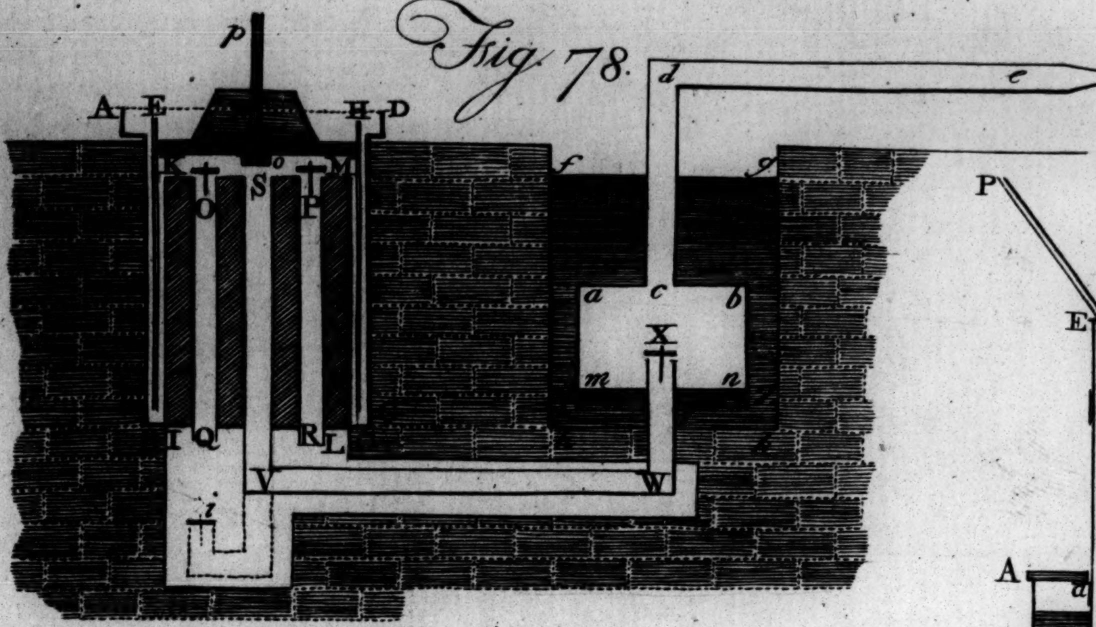


Fig. 78.
p
A
E
H
D
K
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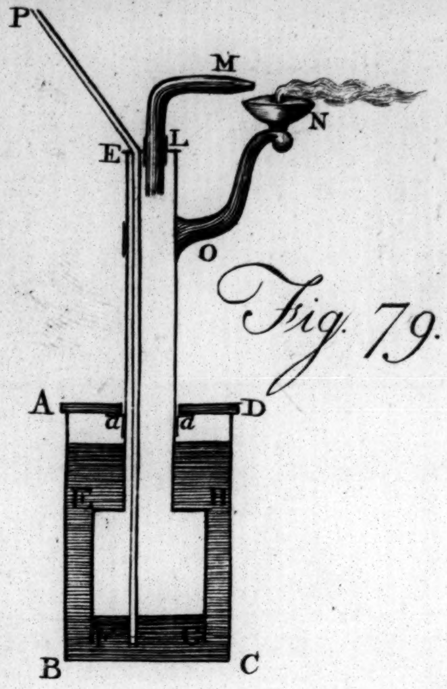
Fig. 79.
P
M
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B
C

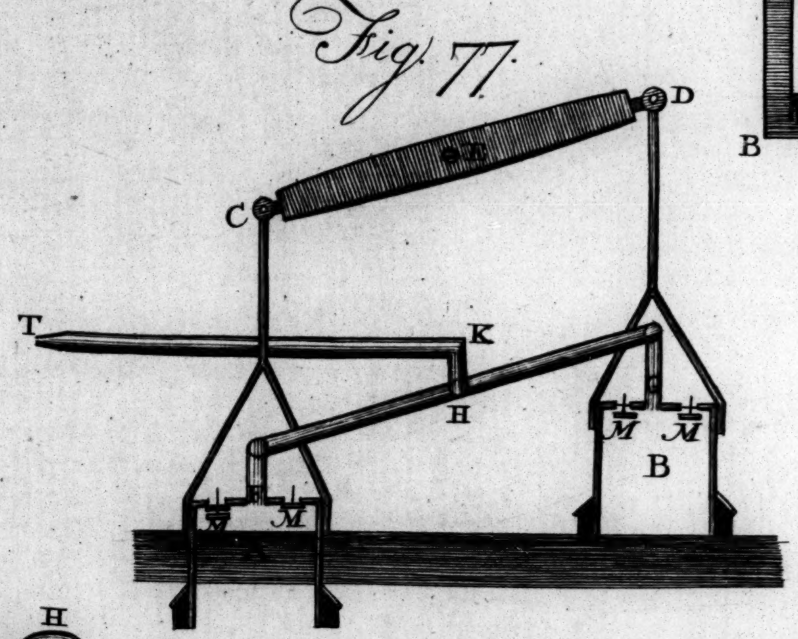


Fig. 77.

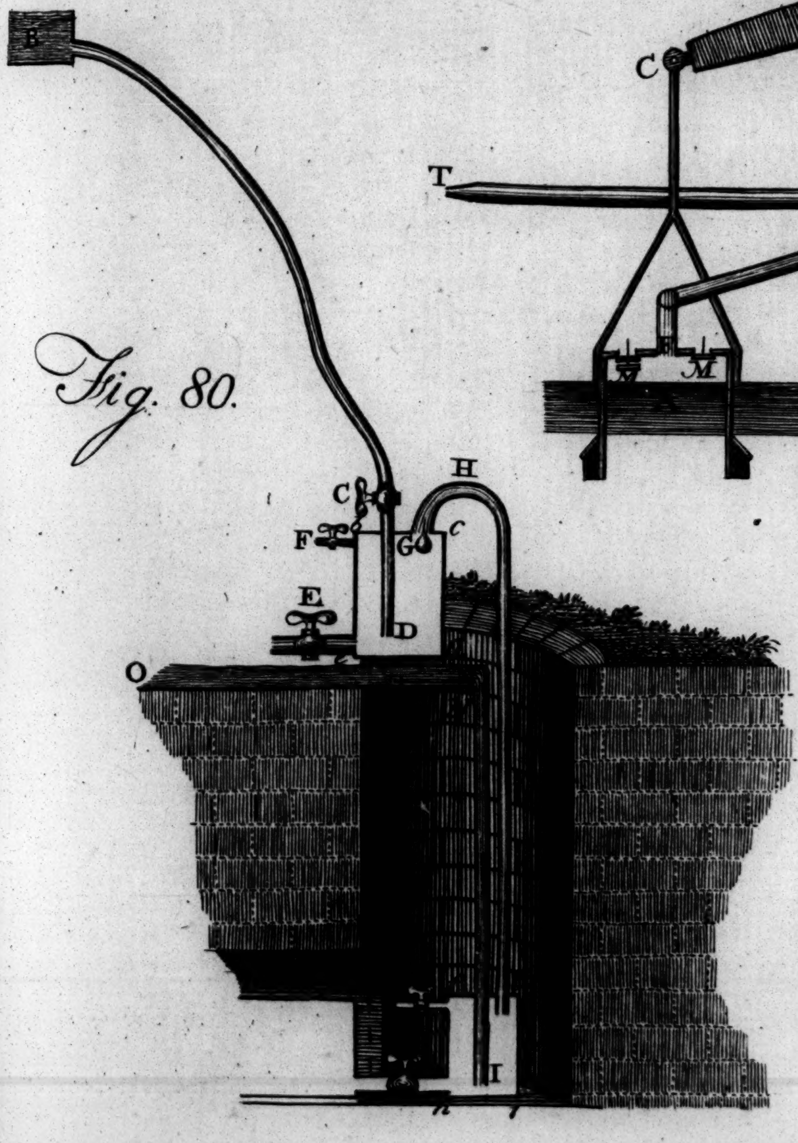


Fig. 80.

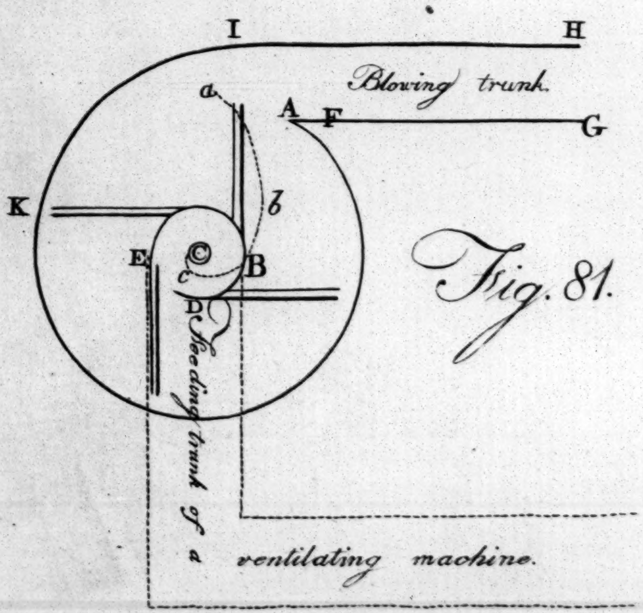


Fig. 81.
I
H
Blowing trunk.
a
A
F
G
K
b
E
B
c
D
Feeding trunk of a ventilating machine.

BRITISH MUSEUM

PNEUMATICS

Plate CCCCVIII

Cuthbertsons Air pump.

Fig. 1.

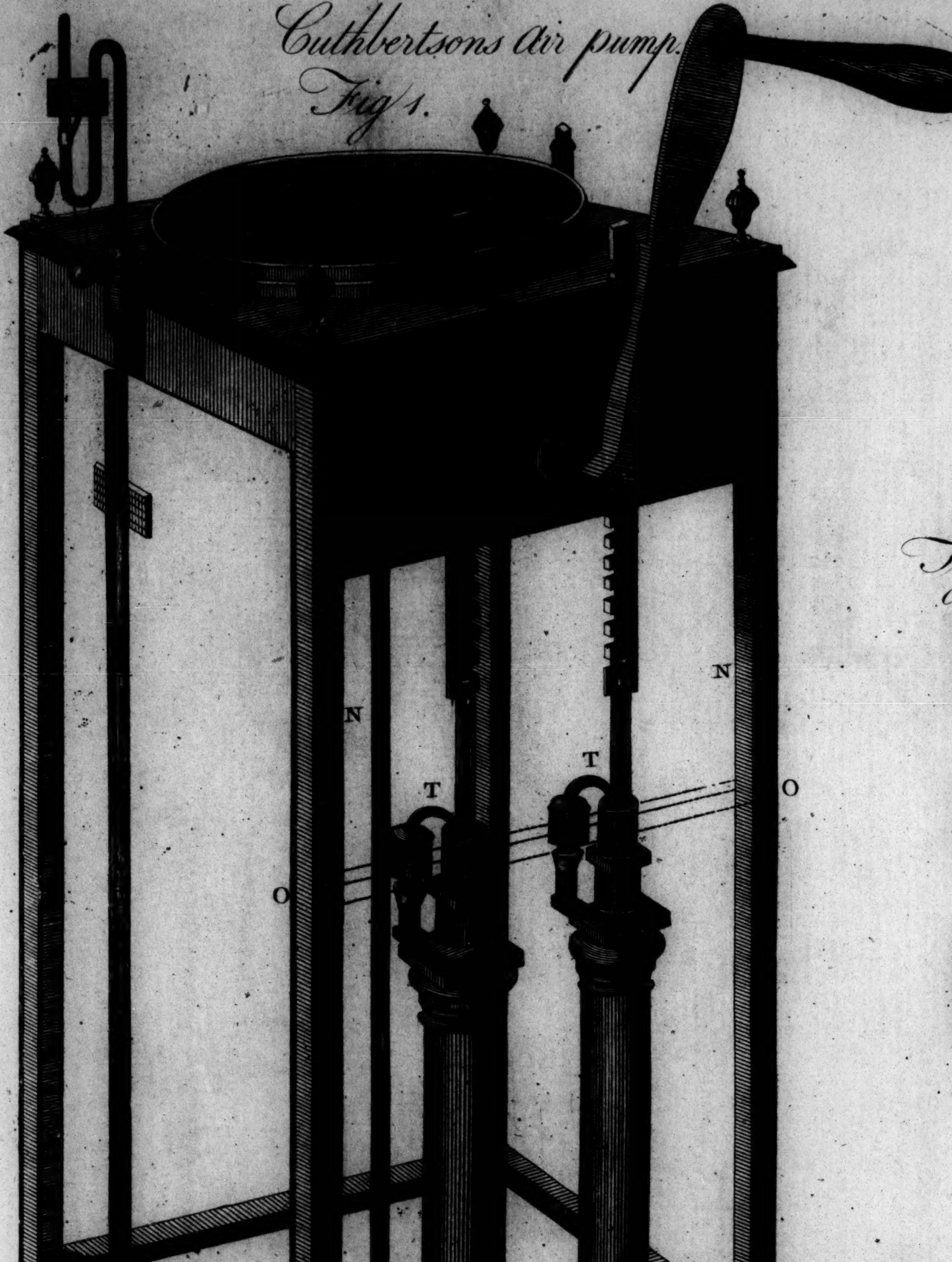
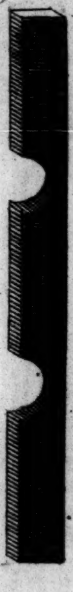


Fig. 2.



S'mither Sculp.

BRITISH MUSEUM

PNEUMATICS.

Plate CCCCIX.

Section of Cuthbertsons air pump. Fig. 7.

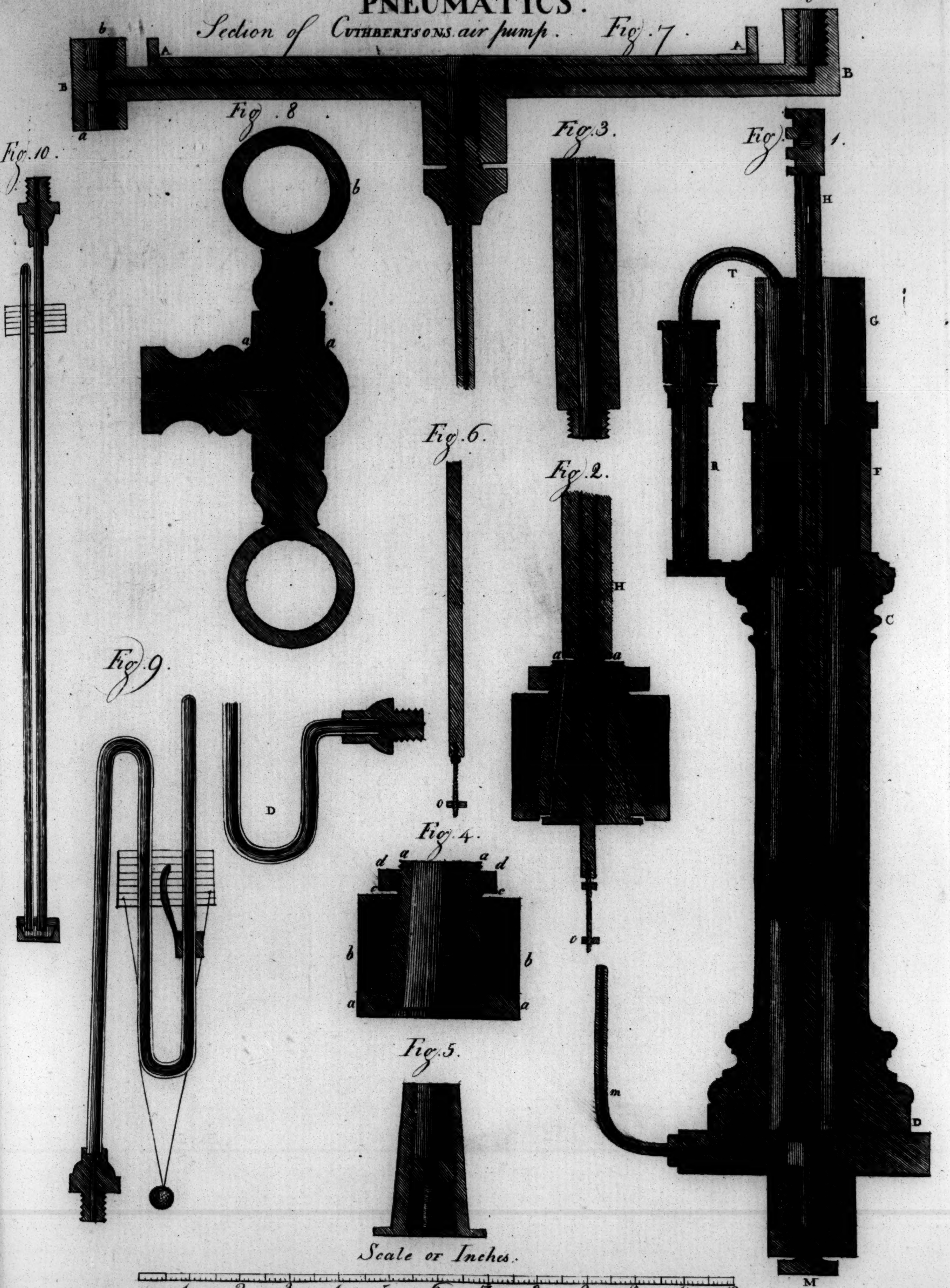

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Fig. 8
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Fig. 10
Fig. 3
Fig. 1
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Fig. 9
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Fig. 4
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Fig. 5
M
Scale of Inches.
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Trenchard

BRITISH MUSEUM

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PODEX, in anatomy, the ſame with Anus.

PODGRAJE. See Asisia.

PODOLIA, a province of Poland, bounded on the eaſt by Volhinia and the river Ukrain; on the north and north-eaſt, by Budſiac Tartary; on the ſouth-eaſt, by the river Nieſter, which ſeparates it from Beſſarabia and Moldavia in European Turkey on the ſouth-weſt; and by the province of Red Ruſſia on the north-weſt. It is uſually divided into the Upper and Lower. In the Upper, which is the weſtern part, the chief town in Kamieck, the capital of Podolia, and of a palatinate. In the Lower or eaſtern part of Podolia, the chief town is Bracklaw, the capital of a palatinate.

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Our author gives the following deſcription of it in its preſent ſtate. It is, ſays he, of an oblong figure, about two miles and a half in circumference. It has four gates, which are oppoſite to each other. On the key-ſtone of the arch of the north gate, on the outſide, is the figure of Neptune in baſſo relievo, and within a hippocampus. The walls which ſtill remain are compoſed of very large cubical ſtones, and are extremely thick, in ſome parts 18 feet. That the walls have remained unto this time is owing to the very exact manner in which the ſtones are fitted to one another (a circumſtance obſerved univerſally in the maſonry of the ancients), and perhaps in ſome meaſure to a ſtalactical concretion which has grown over them. On the walls here and there are placed towers of different heights; thoſe near the gates being much higher and larger than the others, and evidently of modern workmanſhip. He obſerves, that, from its ſituation among marſhes, bituminous and ſulphureous ſprings, Poeſtum muſt have been unwholeſome; a circumſtance mentioned by Strabo, *Morboſam eam facit fluvius in paludes diffuſus*. In ſuch a ſituation the water muſt have been bad. Hence the inhabitants were obliged to convey that neceſſary of life from purer ſprings by means of aqueducts, of which many veſtiges ſtill remain.

The principal monuments of antiquity are a theatre, an amphitheatre, and three temples, The theatre and amphitheatre are much ruined. The firſt temple is hexaſtylos, and amphiproſtylos. At one end the pilaſters and two columns which divided the cella from the pronaos are ſtill remaining. Within the cella are two rows of ſmaller columns, with an architrave, which ſupport the ſecond order. This temple our author takes to be of that kind called by Vitruvius *hyphæthros*, and ſupports his opinion by a quotation from that author. The ſecond temple is alſo amphiproſtylos: it has nine columns in front and 18 in flank, and ſeems to be of that kind called by Vitruvius *pſeudodipterus*. The third is likewiſe amphiproſtylos. It has ſix columns in front and 13 in flank. Vitruvius calls this kind of temple *peripteros*. "The columns of theſe temples (ſays our author) are of that kind of Doric order which we find employed in works of the greateſt, antiquity. They are hardly five diameters in height. They are without baſes, which alſo has been urged as a proof of their antiquity; but we do not find that the ancients ever uſed baſes to this order, at leaſt till very late. Vitruvius makes no mention of baſes for this order: and the only inſtance we have of it is in the firſt order of the coliſæum at Rome, which was built by Veſpaſian. The pillars of theſe temples are fluted with very ſhallow flutings in the manner deſcribed by Vitruvius. The columns diminiſh from the bottom, which was the moſt ancient method almoſt univerſally in all the orders. The columns have aſtragals of a very ſingular form; which ſhows the error of thoſe who imagine that that this member was firſt invented with the Ionic order, to which the Greeks gave an aſtragal, and that the Romans were the firſt who applied it to the Doric. The echinus of the capitol is of the ſame form with that of the temple of Corinth deſcribed by Le Roy." See *Swinburne's Travels in the two Sicilies*, vol. ii. p. 131—140.

POET, the author of a poem. See the article POETRY.

Provencal Poets. See TROUBADOURS.

POETRY.

1
Origin of poetry.

AMIDST thoſe thick clouds which envelope the firſt ages of the world, reaſon and hiſtory throw ſome lights on the origin and primitive employment of this divine art. Reaſon ſuggeſts, that before the invention of letters, all the people of the earth had no other method of tranſmitting to their deſcendants the principles of their worſhip, their religious ceremonies, their laws, and the renowned actions of their ſages and heroes, than by poetry; which included all theſe objects in a kind of hymns that fathers ſung to their children, in order to engrave them with indelible ſtrokes in their hearts. Hiſtory not only informs us, that Moſes and Miriam, the firſt authors that are known to mankind, ſung, on the borders of the Red Sea, a ſong of divine praiſe to celebrate the deliverance which the Almighty vouchſafed to the people of Iſrael, by opening a paſſage to them through the waters; but it has alſo tranſmitted to us the ſong itſelf, which is at once the moſt ancient monument and a maſter-piece of poetic compoſition.

The Greeks, a people the moſt ingenious, the moſt animated, and in every ſenſe the moſt accompliſhed, that the world ever produced—ſtrove to raviſh from the Hebrews the precious gift of poetry, which was vouchſafed them by the Supreme Author of all nature, that they might aſcribe it to their falſe deities. According to their ingenious fictions, Apollo became the god of poetry, and dwelt on the hills of Phocis, Parnaſſus, and Helicon whoſe feet were waſhed by the waters of Hyppocrene, of which each mortal that ever drank was ſeized with a ſacred delirium. The immortal ſwans floated on its waves. Apollo was accompanied by the Muſes—thoſe nine learned ſiſters—the daughters of Memory: and he was conſtantly attended by the Graces. Pegaſus, winged courſer, tranſported him with a rapid flight into all the regions of the univerſe. Happy emblems! by which we at this day embelliſh our poetry, as no one has ever yet been able to invent more brilliant images.

The literary annals of all nations afford veſtiges of poetry from the remoteſt ages. They are found among the moſt ſavage of the ancient barbarians, and the moſt deſolate of all the Americans. Nature aſſerts her rights in every country and every age. Tacitus mentions the verſes and the hymns of the Germans, at the time when that rough people yet inhabited the woods, and while their manners were ſtill ſavage. The firſt inhabitants of Runnia, and the other northern countries, thoſe of Gaul, Albion, Iberia, Auſonia, and other nations of Europe, had their poetry, as well as the ancient people of Aſia, and of the known borders of Africa. But the ſimple productions of nature have conſtantly ſomething unformed, rough, and ſavage. The Divine Wiſdom appears to have placed the ingenious and poliſhed part of mankind on the earth, in order to refine that which comes from her boſom rude and imperfect: and thus art has poliſhed poetry, which iſſued quite naked and ſavage from the brains of the firſt of mankind.

But what is Poetry? It would be to abridge the

2 Definition of poetry.

limits of the poetic empire, to contract the ſphere of this divine art ſhould we ſay, in imitation of all the dictionaries and other treatiſes on verſification, That *poetry is the art of making verſes, of lines or periods that are in rhyme or metre.* This is rather a grammatical explanation of the word, than a real definition of the thing, and it would be to degrade poetry thus to define it. The father of criticiſm has denominated poetry, τεχνη μιμητικη, *an imitative art:* but this, though juſt in itſelf, is too general for a definition as it does not diſcriminate poetry from other arts which depend equally on imitation. The juſteſt definition ſeems to be that given by Baron Bielfield *, *That poetry is the art of expreſſing our thoughts by fiction.* In fact, it is after this manner (if we reflect with attention) that all the metaphors and allegories, all the various kinds of fiction, form the firſt materials of a poetic edifice: it is thus that all images, all compariſons, alluſions, and figures, eſpecially thoſe which perſonify moral ſubjects, as virtues and vices, concur to the decorating of ſuch a ſtructure. A work, therefore, that is filled with invention, that inceſſantly preſents images which render the reader attentive and affected, where the author gives intereſting ſentiments to every thing that he makes ſpeak, and where he makes ſpeak by ſenſible figures all thoſe objects which would affect the mind but weakly when clothed in a ſimple proſaic ſtyle, ſuch a work is a poem. While that, though it be in verſe, which is of a didactic, dogmatic, or moral nature, and where the objects are preſented in a manner quite ſimple, without fiction, without images or ornaments, cannot be called *poetry,* but merely a work in verſe; for the art of reducing thoughts, maxims, and periods into rhyme or metre, is very different from the art of poetry.

An ingenious fable, a lively and intereſting romance, a comedy, the ſublime narrative of the actions of a hero, ſuch as the Telemachus of M. Fenelon, though written in proſe, but in meaſured proſe, is therefore a work of poetry; becauſe the foundation and the ſuperſtructure are the productions of genius, as the whole proceeds from fiction; and truth itſelf appears to have employed an innocent and agreeable deception to inſtruct with efficacy. This is ſo true, that the pencil alſo, in order to pleaſe and affect has recourſe to fiction; and this part of painting is called the *poetic compoſition of a picture.* It is therefore by the aid of fiction, that poetry ſo to ſpeak, paints its expreſſions, that it gives a body and a mind to its thoughts, that it animates and exalts that which would otherwiſe have remained arid and inſenſible. It is the peculiar privilege of poetry to exalt inanimate things into animals, and abſtract ideas into perſons. The former licence is ſo common, that it is now conſidered as nothing more than a characteriſtical dialect appropriated by the poets to diſtinguiſh themſelves from the writers of proſe; and it is at the ſame time ſo eſſential, that we queſtion much if this ſpecies of compoſition could ſubſiſt without it: for it will perhaps, upon examination, be found, that in every poetical deſcription ſome of the qualities of Animal Nature are aſcribed to things not having life. Every work, therefore, where the thoughts are expreſſed by fictions or images, is poetic; and every work where they are expreſſed naturally, ſimply, and without ornament, although it be in verſe is proſaic.

3 Verſe, though not eſſential to poetry, one of its excellencies.

Verſe, however, is not to be regarded as foreign or ſuperfluous to poetry. To reduce thoſe images, thoſe fictions, into verſe, is one of the greateſt difficulties in poetry, and one of the greateſt merits in a poem: and for theſe reaſons, the cadence, the harmony of ſounds, particularly that of rhyme, delight the ear to a high degree, and the mind inſenſibly repeats them while the eye reads them. There reſults therefore a pleaſure to the mind and a ſtrong attachment to theſe ornaments: but this pleaſure would be frivolous, and even childiſh, if it were not attended by a real utility. Verſes were invented in the firſt ages of the world, merely to aid and to ſtrengthen the memory: for cadence, harmony, and eſpecially rhyme, afford the greateſt aſſiſtance to the memory that art can invent; and the images, or poetic fictions, that ſtrike our ſenſes, aſſiſt in graving them with ſuch deep traces in our minds, as even time itſelf frequently cannot efface. How many excellent apophthegms, ſentences, maxims, and precepts, would have been buried in the abyſs of oblivion, if poetry had not preſerved them by its harmony? To give more efficacy to this lively impreſſion, the firſt poets ſung their verſes, and the words and phraſes muſt neceſſarily have been reduced, at leaſt to cadence, or they could not have been ſuſceptible of muſical expreſſion. One of the great excellencies, therefore, though not a neceſſary conſtituent, of poetry, conſiſts in its being expreſſed in verſe. See Part III.

PART I. GENERAL PRINCIPLES OF THE ART.

SECT. I. *Of the Eſſence and End of Poetry.*

4 Eſſence of poetry.

THE *eſſence* of *Polite Arts* in general, and conſequently of poetry in particular, conſiſts in *expreſſion;* and we think that, to be poetic, the expreſſion muſt neceſſarily ariſe from *fiction,* or invention. (See the article Art, particularly from n° 12. to the end.) This invention, which is the fruit of happy genius alone, ariſes, 1. From the ſubject itſelf of which we undertake to treat: 2. From the manner in which we treat that ſubject, or the ſpecies of writing of which we make uſe: 3. From the plan that we propoſe to follow in conformity to this manner; and, 4. From the method of executing this plan in its full detail. Our firſt guides, the ancients, afford us no light that can elucidate all theſe objects in general. The precepts which Ariſtotle lays down, relate to epic and dramatic poetry only; and which, by the way, confirms our idea, that antiquity itſelf made the eſſence of poetry to conſiſt in fiction, and not in that ſpecies of verſe which is deſtitute of it, or in that which is not capable of it. But ſince this art has arrived to a great degree of perfection; and as poetry, like electricity, communicates its fire to every thing it touches, and animates and embelliſhes whatever it treats; there ſeems to be no ſubject in the univerſe to which poetry cannot be applied, and which it cannot render equally brilliant and pleaſing. From this univerſality of poetry, from its peculiar property of expreſſion by fiction, which is applicable to all ſubjects, have ariſen its different ſpecies, of which a particular deſcription will be given in the *ſecond* part.

Horace, in a well-known verſe, has been ſuppoſed to declare the *end* of poetry to be twofold, to pleaſe, or to inſtruct:

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* Elem. of Univ. Erud.

Aut prodeſſe volunt, aut delectare poetæ.

5
End of poetry.

But Dr Beattie * maintains, that the ultimate end of this art is to pleaſe; inſtruction being only one of the means (and not always a neceſſary one) by which that ultimate end is to be accompliſhed. The paſſage rightly underſtood, he obſerves will not appear to contain any thing inconſiſtent with this doctrine. The author is there ſtating a compariſon between the Greek and Roman writers, with a view to the poetry of the ſtage; and, after commending the former for their correctneſs, and for the liberal ſpirit wherewith they conducted their literary labours, and blaming his countrymen for their inaccuracy and avarice, he proceeds thus: "The ends propoſed by our dramatic poets (or by poets in general) are, to pleaſe, to inſtruct, or to do both. When inſtruction is your aim, let your moral ſentences be expreſſed with brevity, that they may be readily underſtood, and long remembered: where you mean to pleaſe, let your fictions be comformable to truth, or probability. The elder part of your audience (or readers) have no reliſh for poems that give pleaſure only without inſtruction; nor the younger for ſuch writings as give inſtruction without pleaſure. He only can ſecure the univerſal ſuffrage in his favour, who blends the uſeful with the agreeable, and delights at the ſame time that he inſtructs the reader. Such are the works that bring money to the bookſeller, that paſs into foreign countries, and perpetuate the author's name through a long ſucceſſion of ages †."—Now, what is the meaning of all this? What, but that to the *perfection* of dramatic poetry (or, if you pleaſe, of poetry in general) both ſound morals and beautiful fiction are requiſite? But Horace never meant to ſay, that inſtruction, as well as pleaſure, is neceſſary to give to any compoſition the *poetical character*; or he would not in another place have celebrated with ſo much affection and rapture the melting ſtrains of Sappho, and the playful genius of Anacreon ‡,—two authors tranſcendently ſweet, but not remarkably inſtructive. We are ſure, that pathos, and harmony, and elevated language, were, in Horace's opinion, eſſential to poetry §; and of theſe decorations nobody will affirm that inſtruction is the end, who conſiders that the moſt inſtructive books in the world are written in plain proſe.

In ſhort, our author has endeavoured by many ingenious arguments and illuſtrations to eſtabliſh it as a truth in criticiſm, that the end of poetry is *to pleaſe*. Verſes, if pleaſing, may be poetical, though they convey little or no inſtruction; but verſes, whoſe ſole merit it is that they convey inſtruction, are not poetical. Inſtruction, however, he admits, eſpecially in poems of length, is neceſſary to their *perfection*, becauſe they would not be *perfectly agreeable* without it.

SECT. II. *Of the Standard of Poetical Invention.*

6
Poetical invention to be regulated.

HOMER's beautiful deſcription of the heavens and earth, as they appear in a calm evening by the light of the moon and ſtars, concludes with this circumſtance, "And the heart of the ſhepherd is glad ¶." Madame Dacier, from the turn ſhe gives to the paſſage in her verſion ſeems to think, and Pope, in order perhaps to make out his couplet, inſinuates, that the gladneſs of the ſhepherd is owing to his ſenſe of the utility of thoſe luminaries. And this may in part be the caſe: but this is not in Homer; nor is it a neceſſary conſideration. It is true, that, in contemplating the material univerſe, they who diſcern the cauſes and effects of things muſt be more rapturouſly entertained than thoſe who perceive nothing but ſhape and ſize, colour and motion. Yet, in the mere outſide of Nature's works, there is a ſplendor and a magnificence to which even untutored minds cannot attend without great delight.

Beattie's Eſſays, Part I. chap. i.

Not that all peaſants or all philoſophers are equally ſuſceptible of theſe charming impreſſions. It is ſtrange to obſerve the callouſneſs of ſome men, before whom all the glories of heaven and earth paſs in daily ſucceſſio without touching their hearts, elevating their fancy, n, leaving any durable remembrance. Even of thoſe who pretend to ſenſibility, how many are there to whom the luſtre of the riſing or ſetting ſun; the ſparkling concave of the midnight ſky; the mountain-foreſt toſſing and roaring to the ſtorm, or warbling with all the melodies of a ſummer-evening; the ſweet interchange of hill and dale, ſhade and ſunſhine, grove, lawn, and water, which an extenſive landſcape offers to the view; the ſcenery of the ocean, ſo lovely, ſo majeſtic, and ſo tremendous; and the many pleaſing varieties of the animal and vegetable kingdoms, could never afford ſo much real ſatisfaction, as the ſteams and noiſe of a ball-room, the inſipid fiddling and ſqueaking of an opera, or the vexations and wranglings of a card-table!

But ſome minds there are of a different make; who, even in the early part of life, receive from the contemplation of Nature a ſpecies of delight which they would hardly exchange for any other, and who, as avarice and ambition are not the infirmities of that period, would, with equal ſincerity and rapture, exclaim,

> I care not, Fortune, what you me deny;
> You cannot rob me of free Nature's grace;
> You cannot ſhut the windows of the ſky,
> Through which Aurora ſhows her bright'ning face;
> You cannot bar my conſtant feet to trace
> The woods and lawns by living ſtream at eve.
>
> *Caſtle of Indolence.*

Such minds have always in them the ſeeds of true taſte, and frequently of imitative genius. At leaſt, though their enthuſiaſtic or viſionary turn of mind (as the man of the world would call it) ſhould not always incline them to practiſe poetry or painting, we need not ſcruple to affirm, that without ſome portion of this enthuſiaſm no perſon ever became a true poet or painter. For he who would imitate the works of nature, muſt firſt accurately obſerve them; and accurate obſervation is to be expected from thoſe only who take great pleaſure in it.

To a mind thus diſpoſed no part of creation is indifferent. In the crowded city and howling wilderneſs; in the cultivated province and ſolitary iſle; in the flowery lawn and craggy mountain; in the murmur of the rivulet and in the uproar of the ocean; in the radiance of ſummer and gloom of winter: in the thunder of heaven and in the whiſper of the breeze; he ſtill finds ſomething to rouze or to ſoothe his imagination, to draw forth his affections, or to employ his underſtanding. And from every mental energy that is not attended with pain, and even from ſome of thoſe that are, as moderate terror and pity, a ſound mind derives ſatisfaction; exerciſe being equally neceſſary to the body and the ſoul, and to both equally productive of health and pleaſure.

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* Eſſays on Poetry and Muſic, Part I. chap. i.

† Hor. Ar. Poet. 333--347.

‡ Hor. Carm. lib. 4 ode 9.

§ Hor. Sat. lib i. ſat 4. ver. 40.

¶ Iliad, b. 8. v. 555.

This happy ſenſibility to the beauties of nature ſhould be cheriſhed in young perſons. It engages them to contemplate the Creator in his wonderful works; it purifies and harmonizes the ſoul, and prepares it for moral and intellectual diſcipline; it ſupplies an endleſs ſource of amuſement; it contributes even to bodily health: and, as a ſtrict analogy ſubſiſts between material and moral beauty, it leads the heart by an eaſy tranſition from the one to the other; and thus recommends virtue for its tranſcendant lovelineſs, and makes vice appear the object of contempt and abomination. An intimate acquaintance with the beſt deſcriptive poets, Spenſer, Milton, and Thomſon, but above all with the divine Georgic, joined to ſome practice in the art of drawing, will promote this amiable ſenſibility in early years: for then the face of nature has novelty ſuperadded to its other charms, the paſſions are not pre-engaged, the heart is free from care, and the imagination warm and romantic.

7
By the ſtandard of nature.

But not to inſiſt longer on thoſe ardent emotions that are peculiar to the enthuſiaſtic diſciple of nature, may it not be affirmed of all men, without exception, or at leaſt of all the enlightened part of mankind, that they are gratified by the contemplation of things natural, as oppoſed to unnatural? Monſtrous ſights pleaſe but for a moment, if they pleaſe at all; for they derive their charm from the beholder's amazement, which is quickly over. We read indeed of a man of rank in Sicily*, who chooſes to adorn his villa with pictures and ſtatues of moſt unnatural deformity: but it is a ſingular inſtance; and one would not be much more ſurpriſed to hear of a perſon living without food, or growing fat by the uſe of poiſon. To ſay of any thing, that it is *contrary to nature*, denotes cenſure and diſguſt on the part of the ſpeaker; as the epithet *natural* intimates an agreeable quality, and ſeems for the moſt part to imply, that a thing is as it ought to be, ſuitable to our own taſte, and congenial with our own conſtitution. Think with what ſentiments we ſhould peruſe a poem, in which nature was totally miſrepreſented, and principles of thought, and of operation ſuppoſed to take place, repugnant to every thing we had ſeen or heard of:—in which, for example, avarice and coldneſs were aſcribed to youth, and prodigality and paſſionate attachment to the old; in which men were made to act at random, ſometimes according to character, and ſometimes contrary to it; in which cruelty and envy were productive of love, and beneficence and kind affection of hatred; in which beauty was invariably the object of diſlike, and uglineſs of deſire; in which ſociety was rendered happy by atheiſm and the promiſcuous perpetration of crimes, and juſtice and fortitude were held in univerſal contempt. Or think, how we ſhould reliſh a painting, where no regard was had to the proportions, colours, or any of the phyſical laws of Nature:—where the ears and eyes of animals were placed in their ſhoulders; where the ſky was green and the graſs crimſon; where trees grew with their branches in the earth and their roots in the air; where men were ſeen fighting after their heads were cut off, ſhips ſailing on the land, lions entangled in cobwebs, ſheep preying on dead carcaſes, fiſhes ſporting in the woods, and elephants walking on the ſea. Could ſuch figures and combinations give pleaſure, or merit the appellation of ſublime or beautiful? Should we heſitate to pronounce their author mad? And are the abſurdities of madmen proper ſubjects either of amuſement or of imitation to reaſonable beings?

Let it be remarked, too, that though we diſtinguiſh our internal powers by different names, becauſe otherwiſe we could not ſpeak of them ſo as to be underſtood, they are all but ſo many energies of the ſame individual mind; and therefore it is not to be ſuppoſed, that what contradicts any one leading faculty ſhould yield permanent delight to the reſt. That cannot be agreeable to reaſon, which conſcience diſapproves; nor can that gratify imagination, which is repugnant to reaſon.——Beſides, belief and acquieſcence of mind are pleaſant, as diſtruſt and diſbelief are painful: and therefore, that only can give ſolid and general ſatisfaction, which has ſomething of plauſibility in it; ſomething which we conceive it poſſible for a rational being to believe. But no rational being can acquieſce in what is obviouſly contrary to nature, or implies palpable abſurdity.

Poetry, therefore, and indeed every art whoſe end is to pleaſe, muſt be natural; and if ſo, muſt exhibit real matter of fact, or ſomething like it; that is, in other words, muſt be either according to truth or according to veriſimilitude.

And tho' every part of the material univerſe abounds in objects of pleaſurable contemplation, yet nothing in nature ſo powerfully touches our hearts, or gives ſo great variety of exerciſe to our moral and intellectual faculties, as man. Human affairs and human feelings are univerſally intereſting. There are many who have no great reliſh for the poetry that delineates only irrational or inanimate beings; but to that which exhibits the fortunes, the characters, and the conduct of men, there is hardly any perſon who does not liſten with ſympathy and delight. And hence, to imitate human action, is conſidered by Ariſtotle as eſſential to this art; and muſt be allowed to be eſſential to the moſt pleaſing and moſt inſtructive part of it, Epic and Dramatic compoſition. Mere deſcriptions, however beautiful, and moral reflections, however juſt, become tireſome, where our paſſions are not occaſionally awakened by ſome event that concerns our fellow men. Do not all readers of taſte receive peculiar pleaſure from thoſe little tales or epiſodes with which Thomſon's deſcriptive poem on the Seaſons is here and there enlivened? and are they not ſenſible, that the thunder-ſtorm would not have been half ſo intereſting without the tale of the two lovers (*Summ.* v. 1171); nor the harveſt-ſcene, without that of Palemon and Lavinia (*Aut.* v. 177.); nor the driving ſnows, without that exquiſite picture of a man periſhing among them (*Winter*, v. 276.)? It is much to be regretted, that Young did not employ the ſame artifice to animate his Night-Thoughts. Sentiments and deſcriptions may be regarded as the pilaſters, carvings, gildings, and other decorations of the poetical fabric: but human actions are the columns and the rafters that give it ſtability and elevation. Or, changing the metaphor, we may conſider theſe as the ſoul which informs the lovely frame; while thoſe are little more than the ornaments of the body.

Whether the pleaſure we take in things natural, and

*Brydone's Tour in Sicily, let. 24.

8
Habit has great influence over ſentiment and feeling, and of courſe upon poetry.

our diſlike to what is the reverſe, be the effect of habit or of conſtitution is not a material enquiry. There is nothing abſurd in ſuppoſing, that between the ſoul, in its firſt formation, and the reſt of nature, a mutual harmony and ſympathy may have been eſtabliſhed, which experience may indeed confirm, but no perverſe habits could entirely ſubdue. As no ſort of education could make man believe the contrary of a ſelf-evident axiom, or reconcile him to a life of perfect ſolitude; ſo we ſhould imagine, that our love of nature and regularity might ſtill remain with us in ſome degree, though we had been born and bred in the Sicilian villa abovementioned, and never heard any thing applauded but what deſerved cenſure, nor cenſured but what merited applauſe. Yet habit muſt be allowed to have a powerful influence over the ſentiments and feelings of mankind: for objects to which we have been long accuſtomed, we are apt to contract a fondneſs: we conceive them readily, and contemplate them with pleaſure; nor do we quit our old tracts of ſpeculation or practice without reluctance and pain. Hence in part ariſes our attachment to our own profeſſions, our old acquaintance, our native ſoil, our homes, and to the very hills, ſtreams, and rocks in our neighbourhood. It would therefore be ſtrange, if man, accuſtomed as he is from his earlieſt days to the regularity of nature, did not contract a liking to her productions and principles of operation.

9
No neceſſity that the poet ſhould exactly copy nature.

Yet we neither expect nor deſire, that every human invention, where the end is only to pleaſe, ſhould be an exact tranſcript of real exiſtence. It is enough, that the mind acquieſce in it as probable or plauſible, or ſuch as we think might happen without any direct oppoſition to the laws of nature:—Or, to ſpeak more accurately, it is enough that it be conſiſtent, either, firſt, with general experience; or, ſecondly, with popular opinion; or, thirdly, that it be conſiſtent with itſelf, and connected with probable circumſtances.

Firſt: If a human invention be conſiſtent with *general* experience, we acquieſce in it as ſufficiently probable. *Particular* experiences, however, there may be, ſo uncommon, and ſo little expected, that we ſhould not admit their probability, if we did not know them to be true. No man of ſenſe believes, that he has any likelihood of being enriched by the diſcovery of hidden treaſure; or thinks it probable, on purchaſing a lottery-ticket, that he ſhall gain the firſt prize: and yet great wealth has actually been acquired by ſuch good fortune. But we ſhould look upon theſe as poor expedients in a play or romance for bringing about a happy cataſtrophe. We expect that fiction ſhould be more conſonant to the general tenor of human affairs; in a word, that not poſſibility, but probability, ſhould be the ſtandard of poetical invention.

10
Fiction ſufficiently conformable to nature when it accords with received opinions.

Secondly: Fiction is admitted as conformable to this ſtandard, when it accords with received opinions. Theſe may be erroneous, but are not often *apparently* repugnant to nature. On this account, and becauſe they are familiar to us from our infancy, the mind readily acquieſces in them, or at leaſt yields them that degree of credit which is neceſſary to render them pleaſing: hence the fairies, ghoſts, and witches of Shakeſpeare, are admitted as probable beings; and angels obtain a place in religous pictures, though we know that they do not now appear in the ſcenery of real life. A poet who ſhould at this day make the whole action of his tragedy depend upon enchantment, and produce the chief events by the aſſiſtance of ſupernatural agents, would indeed be cenſured as tranſgreſſing the bounds of probability, be baniſhed from the theatre to the nurſery, and condemned to write fairy tales inſtead of tragedies. But Shakeſpeare was in no danger of ſuch cenſures: In his days the doctrine of witchcraft was eſtabliſhed both by law and by the faſhion; and it was not only unpolite, but criminal, to doubt it. Now indeed it is admitted only by the vulgar; but it does not therefore follow that an old poem built upon it ſhould not be acceptable to the learned themſelves. When a popular opinion has long been exploded, and has become repugnant to philoſophical belief, the fictions built upon it are ſtill admitted as natural, both becauſe we all remember to have liſtened to them in childhood with ſome degree of credit, and becauſe we know that they were accounted natural by the people to whom they were firſt addreſſed; whoſe ſentiments and views of things we are willing to adopt, when, by the power of pleaſing deſcription, we are introduced into their ſcenes, and made acquainted with their manners. Hence we admit the theology of the ancient poets, their Elyſium and Tartarus, Scylla and Charybdis, Cyclops and Circe, and the reſt of thoſe "beautiful wonders" (as Horace calls them) which were believed in the heroic ages; as well as the demons and enchantments of Taſſo, which may be ſuppoſed to have obtained no ſmall degree of credit among the Italians of the 16th century, and are ſuitable enough to the notions that prevailed univerſally in Europe not long before (A). In fact, when poetry is in other reſpects true, when it gives an accurate diſplay of thoſe parts of nature about which we know that men in all ages muſt have entertained the ſame opinion, namely, thoſe appearances in the viſible creation, and thoſe feelings and workings of the human mind, which are obvious to all mankind;—when poetry is thus far according to nature, we are very willing to be indulgent to what is fictitious in it, and to grant a temporary allowance to any ſyſtem of fable which the author pleaſes to adopt; provided that he lay the ſcene in a diſtant country, or fix the date to a remote period. This is no unreaſonable piece of complaiſance; we owe it both to the poet and to ourſelves; for without it we ſhould neither form a right eſtimate of his genius, nor receive from his works that pleaſure which they were intended to impart. Let him, however, take care, that his ſyſtem of fable be ſuch as his countrymen and cotemporaries (to whom his work is immediately addreſſed) might be ſuppoſed capable of yielding their aſſent to; for otherwiſe we ſhould not believe him to be in earneſt: and let him connect it as much

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(A) In the 14th century, the common people of Italy believed, that the poet Dante went down to hell; that the *Inferno* was a true account of what he ſaw there; and that his ſallow complexion, and ſtunted beard (which ſeemed by its growth and colour to have been too near the fire), were the conſequence of his paſſing ſo much of his time in that hot and ſmoky region. See *Vicende della Literatura del Sig. C. Denina*, cap. 4.

much as he can with probable circumſtances, and make it appear in a ſeries of events conſiſtent with itſelf.

For (thirdly) if this be the caſe, we ſhall admit hiſtory as probable, or at leaſt as natural, and conſequently be intereſted in it, even though it be not warranted by general experience, and derive but ſlender authority from popular opinion. Calyban, in the Tempeſt, would have ſhocked the mind as an improbability, if we had not been made acquainted with his origin, and ſeen his character diſplayed in a ſeries of conſiſtent behaviour. But when we are told that he ſprung from a witch and a demon, a connection not contrary to the laws of nature, as they were underſtood in Shakeſpeare's time, and find his manners conformable to his deſcent, we are eaſily reconciled to the fiction. In the ſame ſenſe, the Lilliputians of Swift may paſs for probable beings; not ſo much becauſe we know that a belief in pigmies was once current in the world (for the true ancient pigmy was at leaſt thrice as tall as thoſe whom Gulliver viſited), but becauſe we find that every circumſtance relating to them accords with itſelf, and with their ſuppoſed character. It is not the ſize of the people only that is diminutive; their country, ſeas, ſhips, and towns, are all in exact proportion; their theological and political principles, their paſſions, manners, cuſtoms, and all the parts of their conduct, betray a levity and littleneſs perfectly ſuitable; and ſo ſimple is the whole narration, and apparently ſo artleſs and ſincere, that we ſhould not much wonder if it had impoſed (as we have been told it has) upon ſome perſons of no contemptible underſtanding. The ſame degree of credit may perhaps for the ſame reaſons be due to his giants. But when he grounds his narrative upon a contradiction to nature: when he preſents us with rational brutes, and irrational men; when he tells us of horſes building houſes for habitation, milking cows for food, riding in carriages, and holding converſations on the laws and politics of Europe, not all his genius (and he there exerts it to the utmoſt) is able to reconcile us to ſo monſtrous a fiction: we may ſmile at ſome of his abſurd exaggerations; we may be pleaſed with the energy of ſtyle, and accuracy of deſcription, in particular places; and a malevolent heart may triumph in the ſatire; but we can never reliſh it as a fable, becauſe it is at once unnatural and ſelf-contradictory. Swift's judgment ſeems to have forſaken him on this occaſion: he wallows in naſtineſs and brutality: and the general run of his ſatire is downright defamation. Lucian's *True Hiſtory* is a heap of extravagancies put together without order or unity, or any other apparent deſign than to ridicule the language and manner of grave authors. His ravings, which have no better right to the name of *fable*, than a hill of rubbiſh has to that of palace, are deſtitute of every colour of plauſibility. Animal trees, ſhips ſailing in the ſky, armies of monſtrous things travelling between the ſun and moon on a pavement of cobwebs, rival nations of men inhabiting woods and mountains in a whale's belly,—are liker the dreams of a bedlamite than the inventions of a rational being.

11 And is conſiſtent with itſelf.

Beattie's Eſſays, ut ſupra.

12 A ſtricter probability requiſite in ſome kinds of poetry than in others.

If we were to proſecute this ſubject any farther, it would be proper to remark, that in ſome kind of poetical invention a ſtricter probability is required than in others:—that, for inſtance, Comedy, whether dramatic or narrative (B), muſt ſeldom deviate from the ordinary courſe of human affairs, becauſe it exhibits the manners of real and even of familiar life:—that the tragic poet becauſe he imitates characters more exalted and generally refers to events little known, or long ſince paſt, may be allowed a wider range; but muſt never attempt the marvellous fictions of an epic muſe, becauſe he addreſſes his work, not only to the paſſions and imagination of mankind, but alſo to their eyes and ears, which are not eaſily impoſed on, and refuſe to be gratified with any repreſentation that does not come very near the truth:—that the epic poem may claim ſtill ampler privileges, becauſe its fictions are not ſubject to the ſcrutiny of any outward ſenſe, and becauſe it conveys information in regard both to the higheſt human characters, and the moſt important and wonderful events, and alſo to the affairs of unſeen worlds and ſuperior beings. Nor would it be improper to obſerve, that the ſeveral ſpecies of comic, of tragic, of epic compoſition, are not confined to the ſame degree of probability: for that farce may be allowed to be leſs probable than the regular comedy; the maſque than the regular tragedy; and the mixed epic, ſuch as the Fairy Queen, and Orlando Furioſo, than the pure epopee of Homer, Virgil, and Milton. But this part of the ſubject ſeems not to require further illuſtration. Enough has been ſaid to ſhow, that nothing unnatural can pleaſe; and that therefore poetry, whoſe end is to pleaſe, muſt be *according to nature.*

And if ſo, it muſt be either according to real nature, or according to nature ſomewhat different from the reality.

SECT. III. *Of the Syſtem of Nature exhibited by Poetry.*

13 Hiſtorians embelliſh their works by fiction, and make them

To exhibit *real nature* is the buſineſs of the hiſtorian; who, if he were ſtrictly to confine himſelf to his own ſphere, would never record even the minuteſt circumſtance of any ſpeech, event, or deſcription, which was not warranted by ſufficient authority. It has been the language of critics in every age, that the hiſtorian ought to relate nothing as true which is falſe or dubious, and to conceal nothing material which he knows to be true. But it is to be doubted whether any writer of profane hiſtory has ever been ſo ſcrupulous. Thucydides himſelf, who began his hiſtory when that war began which he records, and who ſet down every event ſoon after it happened, according to the moſt authentic information, ſeems, however, to have indulged his fancy not a little in his harangues and deſcriptions, particularly that of the plague of Athens: and the ſame thing has been practiſed, with greater latitude, by Livy and Tacitus, and more or leſs by all the beſt hiſtorians both ancient and modern. Nor are they to be blamed for it. By theſe improved or invented ſpeeches, and by the heightenings thus given to their deſcriptions, their work becomes more intereſting, and more uſeful; nobody is deceived,

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(B) Fielding's *Tom Jones*, *Amelia*, and *Joſeph Andrews*, are examples of what may be called the *Epic* or *Narrative Comedy*, or more properly perhaps the *Comic Epopee*.

ceived, and hiſtorical truth is not materially affected. A medium is however, to be obſerved in this, as in other things. When the hiſtorian lengthens a deſcription into a detail of fictitious events, as Voltaire has done in his account of the battle of Fontenoy, he loſes his credit with us, by raiſing a ſuſpicion that he is more intent upon a pretty ſtory than upon the truth. And we are diſguſted with his inſincerity, when, in defiance even of veriſimilitude, he puts long elaborate orations in the mouth of thoſe, of whom we know either from the circumſtances that they could not, or from more authentic records that they did not, make any ſuch orations; as Dionyſius of Halicarnaſſus has done in the caſe of Volumnia haranguing her ſon Coriolanus, and Flavius Joſephus in that of Judah addreſſing his brother as viceroy of Egypt. From what theſe hiſtorians relate, one would conjecture that the Roman matron had ſtudied at Athens under ſome long-winded rhetorician, and that the Jewiſh patriarch muſt have been one of the moſt flowery orators of antiquity. But the fictitious part of hiſtory, or of ſtory telling, ought never to take up much room; and muſt be highly blameable when it leads into any miſtake either of facts or of characters.

14
In ſome degree poetical.

Now, why do hiſtorians take the liberty to embelliſh their works in this manner? One reaſon, no doubt is, that they may diſplay their talents in oratory and narration: but the chief reaſon, as hinted already, is, to render their compoſition more agreeable. It would ſeem, then, that ſomething more pleaſing than real nature or ſomething which ſhall add to the pleaſing qualities of real nature, may be deviſed by human fancy. And this may certainly be done. And this it is the poet's buſineſs to do. And when this is in any degree done by the hiſtorian, his narrative becomes in that degree poetical.

Beattie's Eſſays, chap. ii.

15
Poets embelliſh nature itſelf.

The poſſibility of thus improving upon nature muſt be obvious to every one. When we look at a landſcape, we can fancy a thouſand additional embelliſhments. Mountains loftier and more pictureſque; rivers more copious, more limpid, and more beautifully winding; ſmoother and wider lawns; valleys more richly diverſified; caverns and rocks more gloomy and more ſtupendous; ruins more majeſtic; buildings more magnificent; oceans more varied with iſlands, more ſplendid with ſhipping, or more agitated by ſtorm, than any we have ever ſeen—it is eaſy for human imagination to conceive. Many things in art and nature exceed expectation; but nothing ſenſible tranſcends or equals the capacity of thought:—a ſtriking evidence of the dignity of the human ſoul? The fineſt woman in the world appears to every eye ſuſceptible of improvement, except perhaps to that of her lover. No wonder, then, if in poetry events can be exhibited more compact, and of more pleaſing variety, than thoſe delineated by the hiſtorian, and ſcenes of inanimate nature more dreadful or more lovely, and human characters more ſublime and more exquiſite, both in good and evil. Yet ſtill let nature ſupply the ground-work and materials, as well as the ſtandard, of poetical fiction. The moſt expert painters uſe a layman, or other viſible figure, to direct their hand and regulate their fancy. Homer himſelf founds his two poems on authentic tradition; and tragic as well as epic poets have followed the example. The writers of romance, too, are ambitious to interweave true adventures with their fables; and when it can be conveniently done, to take the outlines of their plan from real life. Thus the tale of Robinſon Cruſoe is founded on an incident that actually befel one Alexander Selkirk, a ſea-faring man, who lived ſeveral years alone in the iſland of Juan Fernandes: Smollet is thought to have given us ſeveral of his own adventures in the hiſtory of Roderic Random: and the chief characters in Tom Jones, Joſeph Andrews, and Pamela, are ſaid to have been copied from real originals. Dramatic comedy, indeed, is for the moſt part purely fictitious: for if it were to exhibit real events as well as preſent manners, it would become too perſonal to be endured by a well-bred audience, and degenerate into downright abuſe; which appears to have been the caſe with the old comedy of the Greeks*. But in general, hints taken from real exiſtence will be found to give no little grace and ſtability to fiction even in the moſt fanciful poems. Thoſe hints, however, may be improved by the poet's imagination, and ſet off with every probable ornament that can be deviſed, conſiſtently with the deſign and genius of the work; or, in other words, with the ſympathies that the poet means to awaken in the mind of his reader. For mere poetical ornament, when it fails to intereſt the affections, is not only uſeleſs, but improper; all true poetry being addreſſed to the heart, and intended to give pleaſure by raiſing or ſoothing the paſſions;—the only effectual way of pleaſing a rational and moral creature. And therefore we would take Horace's maxim to be univerſal in poetry: "*Non ſatis eſt, pulchra eſſe, poemata;* dulcia *ſunto*:" "It is not enough that poems be beautiful; let them alſo be *affecting*:"— For that this is the meaning of the word *dulcia* in this place, is admitted by the beſt interpreters, and is indeed evident from the context †.

16
And deſcribe even things inanimate ſo as to make them affecting.

That the ſentiments and feelings of percipient beings, when expreſſed in poetry, ſhould call forth our affections, is natural enough; but can deſcriptions of inanimate things alſo be made affecting? certainly they can: and the more they affect, the more they pleaſe us, and the more poetical we allow them to be. Virgil's Georgic is a noble ſpecimen (and indeed the nobleſt in the world) of this ſort of poetry. His admiration of external nature gains upon a reader of taſte, till it riſe to perfect enthuſiaſm. The following obſervations will perhaps explain this matter.

Every thing in nature is complex in itſelf, and bears innumerable relations to other things; and may therefore be viewed in an endleſs variety of lights, and conſequently deſcribed in an endleſs variety of ways. Some deſcriptions are good, and others bad. An hiſtorical deſcription, that enumerates all the qualities of any object, is certainly good, becauſe it is true; but may be as unaffecting as a logical definition. In poetry, no unaffecting deſcription is good, however conformable to truth: for here we expect not a complete enumeration of qualities (the chief end of the art being to pleaſe), but only ſuch an enumeration as may give a lively and intereſting idea. It is not memory, or the knowledge of rules, that can qualify a poet for this ſort of deſcription; but a peculiar livelineſs of fancy and ſenſibility of heart, the nature whereof we may explain by its effects but we cannot lay down rules for the attainment of it.

When our mind is occupied by any emotion, we naturally uſe words and meditate on things that are ſuitable

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* Compare Hor lib. i. ſat. 4. verſ. 1.—5. with Ar. Poet. verſ. 281.—285.

† Hor. Ar. Poet. verſ. 95—100.

17 Every perſon introduced in poetry ſhould ſee things through medium of his ruling paſſion.

Beattie's Eſſays, ut ſupra,

able to it and tend to encourage it. If a man were to write a letter when he is very angry, there would probably be ſomething of vehemence or bitterneſs in the ſtyle, even though the perſon to whom he wrote were not the object of his anger. The ſame thing holds true of every other ſtrong paſſion or emotion:—while it predominates in the mind, it gives a peculiarity to our thoughts, as well as to our voice, geſture, and countenance: And hence we expect, that every perſonage introduced in poetry ſhould ſee things through the medium of his ruling paſſion, and that his thoughts and language ſhould be tinctured accordingly. A melancholy man walking in a grove, attends to thoſe things that ſuit and encourage his melancholy; the ſighing of the wind in the trees, the murmuring of waters, the darkneſs and ſolitude of ſhades: A cheerful man in the the ſame place, finds many ſubjects of cheerful meditation, in the ſinging of birds, the briſk motions of the babbling ſtream, and the livelineſs and variety of the verdure. Perſons of different characters, contemplating the ſame thing, a Roman triumph, for inſtance, feel different emotions, and turn their view to different objects. One is filled with wondef at ſuch a diſplay of wealth and power; another exults in the idea of conqueſt, and pants for military renown; a third, ſtunned with clamour, and haraſſed with confuſion, wiſhes for ſilence, ſecurity, and ſolitude; one melts with pity to the vanquiſhed, and makes many a ſad reflection upon the inſignificance of worldly grandeur, and the uncertainty of human things; while the buffoon, and perhaps the philoſopher, conſiders the whole as a vain piece of pageantry, which by its ſolemn procedure, and by the admiration of ſo many people, is only rendered the more ridiculous:—and each of theſe perſons would deſcribe it in a way ſuitable to his own feelings, and tending to raiſe the ſame in others. We ſee in Milton's Allegro and Penſoroſo, how a different caſt of mind produces a variety in the manner of conceiving and contemplating the ſame rural ſcenery. In the former of theſe excellent poems, the author perſonates a cheerful man, and takes notice of thoſe things in external nature that are ſuitable to cheerful thoughts, and tend to encourage them: in the latter, every object deſcribed is ſerious and ſolemn, and productive of calm reflection and tender mlancholy: and we ſhould not be eaſily perſuaded, that Milton wrote the firſt under the influence of ſorrow, or the ſecond under that of gladneſs. We often ſee an authors's character in his works, and if every author were in earneſt when he writes, we ſhould oftener ſee it. Thomſon was a man of piety and benevolence, and a warm admirer of the beauties of nature; and every deſcription in his delightful poem on the ſeaſons tends to raiſe the ſame laudable affections in his reader. The parts of nature that attract his notice are thoſe which an impious or hard-hearted man would neither attend to, nor be affected with, at leaſt in the ſame manner. In Swift we ſee a turn of mind very different from that of the amiable Thomſon; little reliſh for the ſublime or beautiful, and a perpetual ſucceſſion of violent emotions. All his pictures of human life ſeem to ſhow, that deformity and meanneſs were the favourite objects of his attention, and that his ſoul was a conſtant prey to indignation (c), diſguſt, and other gloomy paſſions, ariſing from ſuch a view of things. And it is the tendency of almoſt all his writings (though it was not always the author's deſign), to communicate the ſame paſſions to his reader: inſomuch that notwithſtanding his erudition and knowledge of the world, his abilities as a popular orator and man of buſineſs, the energy of his ſtyle, the elegance of ſome of his verſes, and his extraordinary talents in wit and humour, there is reaſon to doubt, whether by ſtudying his works any perſon was ever much improved in piety or benevolence.

18 It is thus that poetry affects the heart whatever be its ſubject.

And thus we ſee, how the compoſitions of an ingenious author may operate upon the heart, whatever be the ſubject. The affections that prevail in the author himſelf, direct his attention to objects congenial, and give a peculiar bias to his inventive powers, and a peculiar colour to his language. Hence his work as well as face, if nature is permitted to exert herſelf freely in it, will exhibit a picture of his mind, and awaken correſpondent ſympathies in the reader. When theſe are favourable to virtue, which they always ought to be, the work will have that ſweet pathos to which Horace alludes in the paſſage above mentioned; and which we ſo highly admire, and ſo warmly approve, even in thoſe parts of the Georgic that deſcribe inanimate nature.

Horace's account of the matter in queſtion differs not from what is here given. "It is not enough (ſays he*) that poems be beautiful; let them be affecting, and agitate the mind with whatever paſſions the poet wiſhes to impart. The human countenance, as it ſmiles on thoſe who ſmile, accompanies alſo with ſympathetic tears thoſe who mourn. If you would have me weep, you muſt firſt weep yourſelf; then, and not before, ſhall I be touched with your misfortunes.—For nature firſt makes the emotions of our mind correſpond with our circumſtances infuſing real joy, ſorrow, or reſentment, according to the occaſion: and afterwards gives the true pathetic utterance to the voice and language." This doctrine, which concerns the orator and the player no leſs than the poet, is ſtrictly philoſophical, and equally applicable to dramatic, to deſcriptive, and indeed to every ſpecies of intereſting poetry. The poet's ſenſibility muſt firſt of all engage him warmly in his ſubject, and in every part of it; otherwiſe he will labour in vain to intereſt the reader. If he would paint external nature, as Virgil and Thomſon have done, ſo as to make her amiable to others, he muſt firſt be enamoured of her himſelf; if he would have his heroes and heroines ſpeak the language of love or ſorrow, devotion or courage, ambition or anger, benevolence or pity, his heart muſt be ſuſceptible of thoſe emotions, and in ſome degree feel them, as long at leaſt as he employs himſelf in framing words for them; being aſſured, that

He beſt ſhall paint them who can feel them moſt.
POPE's *Eloiſa*, v. 366.

*Ar. Poet. v. 99--111.

(c) For part of this remark we have his own authority, often in his letters, and very explicitly in the Latin epitaph which he compoſed for himſelf:—"ubi ſæva indignatio ulterius cor lacerare nequit." *See his laſt will and teſtement*

19
The true poet muſt poſſeſs fancy to invent decorations to nature.

The true poet, therefore, muſt not only ſtudy nature, and know the reality of things, but muſt alſo poſſeſs fancy to invent additional decorations; judgment, to direct him in the choice of ſuch as accord with veriſimilitude; and ſenſibility, to enter with ardent emotions into every part of his ſubject, ſo as to tranſfuſe into every part of his work a pathos and energy ſufficient to raiſe correſponding emotions in the reader.

The hiſtorian and the poet (ſays Ariſtotle *) differ in this, that the former exhibits things as they are, the latter as they might be;"—*i. e.* in that ſtate of perfection which is conſiſtent with probability, and in which, for the ſake of our own gratification, we wiſh to find them. If the poet, after all the liberties he is allowed to take with the truth, can produce nothing more exquiſite than is commonly to to be met with in hiſtory, his reader will be diſappointed and diſſatisfied. Poetical repreſentations muſt therefore be framed after a pattern of the higheſt probable perfection that the genius of the work will admit:—external nature muſt in them be more pictureſque than in reality; action more animated; ſentiments more expreſſive of the feelings and character, and more ſuitable to the circumſtances of the ſpeaker; perſonages better accompliſhed in thoſe qualities that raiſe admiration, pity, terror, and other ardent emotions; and events more compact, more clearly connected with cauſes and conſequences, and unfolded in an order more flattering to the fancy, and more intereſting to the paſſions. But where, it may be ſaid, is this pattern of perfection to be found? Not in real nature; otherwiſe hiſtory, which delineates real nature, would alſo delineate this pattern of perfection. It is to be found only in the mind of the poet; and it is imagination, regulated by knowledge, that enables him to form it.

20
Obſervation of many things of the ſame kind a great help to poetical fancy, becauſe

In the beginning of life, and while experience is confined to a ſmall circle, we admire every thing, and are pleaſed with very moderate excellence. A peaſant thinks the hall of his landlord the fineſt apartment in the univerſe, liſtens with rapture to the ſtrolling ballad-ſinger, and wonders at the rude wooden cuts that adorn his ruder compoſitions. A child looks upon his native village as a town; upon the brook that runs by as a river; and upon the meadows and hills in the neighbourhood as the moſt ſpacious and beautiful that can be. But when, after long abſence, he returns in his declining years, to viſit, once before he die, the dear ſpot that gave him birth, and thoſe ſcenes whereof he remembers rather the original charms than the exact proportions; how is he diſappointed to find every thing ſo debaſed and ſo diminiſhed! The hills ſeem to have ſunk into the ground, the brook to be dried up, and the village to be forſaken of its people; the pariſh-church, ſtripped of all its fancied magnificence, is become low, gloomy, and narrow; and the fields are now only the miniature of what they were. Had he never left this ſpot, his notions might have remained the ſame as at firſt; and had he travelled but a little way from it, they would not perhaps have received any material enlargement. It ſeems then to be from obſervation of many things of the ſame or ſimilar kinds, that we acquire the talent of forming ideas more perfect than the real objects that lie immediately around us: and theſe ideas we may improve gradually more and more, according to the vivacity of our mind, and extent of our experience, till at laſt we come to raiſe them to a degree of perfection ſuperior to any thing to be found in real life. There cannot ſure be any myſtery in this doctrine; for we think and ſpeak to the ſame purpoſe every day. Thus nothing is more common than to ſay, that ſuch an artiſt excels all we have ever known in his profeſſion, and yet that we can ſtill conceive a ſuperior performance. A moraliſt, by bringing together into one view the ſeparate virtues of many perſons, is enabled to lay down a ſyſtem of duty more perfect than any he has ever ſeen exemplified in human conduct. Whatever be the emotion the poet intends to raiſe in his reader, whether admiration or terror, joy or ſorrow; and whatever be the object he would exhibit, whether Venus or Tiſiphone, Achilles or Therſites, a palace or a pile of ruins, a dance or a battle; he generally copies an idea of his own imagination: conſidering each quality as it is found to exiſt in ſeveral individuals of a ſpecies, and thence forming an aſſemblage more or leſs perfect in its kind, according to the purpoſe to which he means to apply it.

21
Poetical conceptions muſt be general

Hence it would appear, that the ideas of poetry are rather general than ſingular; rather collected from the examination of a ſpecies or claſs of things, than copied from an individual. And this, according to Ariſtotle, is in fact the caſe, at leaſt for the moſt part; whence that critic determines, that poetry is ſomething more exquiſite and more philoſophical than hiſtory *. The hiſtorian may deſcribe Bucephalus, but the poet delineates a war-horſe; the former muſt have ſeen the animal he ſpeaks of, or received authentic information concerning it, if he mean to deſcribe it hiſtorically; for the latter, it is enough that he has ſeen ſeveral animals of that ſort. The former tells us, what Achilles actually did and ſaid; the latter, what ſuch a ſpecies of human character as that which bears the name of Achilles would probably do or ſay in certain given circumſtances.

It is indeed true, that the poet may, and often does, copy after individual objects. Homer, no doubt, took his characters from the life; or at leaſt, in forming them, was careful to follow tradition as far as the nature of his plan would allow. But he probably took the freedom to add or heighten ſome qualities, and take away others; to make Achilles, for example, ſtronger, perhaps, and more impetuous, and more eminent for filial affection, and Hector more patriotic and more amiable than he really was. If he had not done this, or ſomething like it, his work would have been rather a hiſtory than a poem; would have exhibited men and things as they were, and not as they might have been; and *Achilles* and *Hector* would have been the names of individual and real heroes; whereas, according to Ariſtotle, they are rather to be conſidered as two diſtinct modifications or ſpecies of the heroic character. Shakeſpeare's account of the cliffs of Dover comes ſo near the truth, that we cannot doubt of its having been written by one who had ſeen them: but he who takes it for an exact hiſtorical deſcription, will be ſurpriſed when he comes to the place, and finds thoſe cliffs not half ſo lofty as the poet had made him believe. An hiſtorian would be to blame for ſuch amplification; becauſe, being to deſcribe an individual precipice, he ought to tell us juſt what it is; which if he did, the deſcription would ſuit that place, and perhaps no other in the whole world. But the poet means only to give an idea of what ſuch a precipice may be; and therefore his deſcription may perhaps be equally applicable to many ſuch chalky precipices on the ſea-ſhore.

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* Poetic. ſect. 9.

* Poetic. § 9.

22 In order to pleaſe all ages and countries.

This method of copying after general ideas formed by the artiſt from obſervation of many individuals, diſtinguiſhes the Italian and all the ſublime painters, from the Dutch and their imitators. Theſe give us bare nature, with the imperfections and peculiarities of individual things or perſons; but thoſe give nature improved as far as probability and the deſign of the piece will admit. Tenieres and Hogarth draw faces, and figures, and dreſſes, from real life, and preſent manners; and therefore their pieces muſt in ſome degree loſe the effect, and become aukward, when the preſent faſhions become obſolete.——Raphael and Reynolds take their models from general nature, avoiding, as far as poſſible, (at leaſt in all their great performances), thoſe peculiarities that derive their beauty from mere faſhion; and therefore their works muſt give pleaſure, and appear elegant, as long as men are capable of forming general ideas, and of judging from them. The laſt-mentioned incomparable artiſt is particularly obſervant of children, whoſe looks and attitudes, being leſs under the controul of art and local manners, are more characteriſtical of the ſpecies than thoſe of men and women. This field of obſervation has ſupplied him with many fine figures, particularly that moſt exquiſite one of Comedy, ſtruggling for and winning (for who could reſiſt her!) the affections of Garrick:—a figure which could never have occurred to the imagination of a painter who had confined his views to grown perſons looking and moving in all the formality of polite life;—a figure which in all ages and countries would be pronounced natural and engaging;—whereas thoſe human forms that we ſee every day bowing and courteſying, and ſtrutting, and turning out their toes *ſecundum artem*, and dreſſed in ruffles, and wigs and flounces, and hoop-petticoats, and full-trimmed ſuits, would appear elegant no further than the preſent faſhions are propagated, and no longer than they remain unaltered.

23 The period in the progreſs of human ſociety to which epic and tragic poets ſhould attend.

There is, in the progreſs of human ſociety, as well as of human life, a period to which it is of great importance for the higher order of poets to attend, and from which they will do well to take their characters, and manners, and the era of their events; namely, that wherein men are raiſed above ſavage life, and conſiderably improved by arts, government, and converſation; but not advanced ſo high in the aſcent towards politeneſs, as to have acquired a habit of diſguiſing their thoughts and paſſions, and of reducing their behaviour to the uniformity of the mode. Such was the period which Homer had the good fortune (as a poet) to live in, and to celebrate. This is the period at which the manners of men are moſt pictureſque, and their adventures moſt romantic. This is the period when the appetites unperverted by luxury, the powers unenervated by effeminacy, and the thoughts diſengaged from artificial reſtraint, will, in perſons of ſimilar diſpoſitions and circumſtances, operate in nearly the ſame way and when, conſequently, the characters of particular men will approach to the nature of poetical or general ideas, and, if well imitated, give pleaſure to the whole, or at leaſt to a great majority of mankind. But a character tinctured with the faſhions of polite life would not be ſo generally intereſting. Like a human figure adjuſted by a modern dancing-maſter, and dreſſed by a modern tailor, it may have a good effect in ſatire, comedy, or farce: but if introduced into the higher poetry, it would be admired by thoſe only who had learned to admire nothing but preſent faſhions, and by them no longer than the preſent faſhions laſted; and to all the reſt of the world would appear aukward, unaffecting, and perhaps ridiculous. But Achilles and Sarpedon, Diomede and Hector, Neſtor and Ulyſſes, as drawn by Homer, muſt in all ages, independently on faſhion, command the attention and admiration of mankind, Theſe have the qualities that are univerſally known to belong to human nature; whereas the modern fine gentleman is diſtinguiſhed by qualities that belong only to a particular age ſociety, and corner of the world. We ſpeak not of moral or intellectual virtues, which are objects of admiration to every age; but of thoſe outward accompliſhments, and that particular temperature of the paſſions; which form the moſt perceptible part of a human character.——As, therefore, the politician, in diſcuſſing the rights of mankind, muſt often allude to an imaginary ſtate of nature; ſo the poet who intends to raiſe admiration, pity, terror, and other important emotions, in the generality of mankind, eſpecially in thoſe readers whoſe minds are moſt improved, muſt take his pictures of life and manners, rather from the heroic period we now ſpeak of, than from the ages of refinement; and muſt therefore (to repeat the maxim of Ariſtotle) " exhibit things, not as they are, but as they might be."

SECT. IV. *Of Poetical Characters.*

24 Requiſites to the delineation of poetical characters.

HORACE ſeems to think, that a competent knowledge of moral philoſophy will fit an author for aſſigning the ſuitable qualities, and duties to each poetical perſonage: (*Art. Poet.* v. 309.—316.). The maxim may be true, as far as mere morality is the aim of the poet; but cannot be underſtood to refer to the delineation of poetical characters in general: for a thorough acquaintance with all the moral philoſophy in the world would not have enabled Blackmore to paint ſuch a perſonage as Homer's Achilles, Shakeſpeare's Othello, or the Satan of Paradiſe Loſt. To a competency of moral ſcience, there muſt be added an extenſive knowledge of mankind, a warm and elevated imagination, and the greateſt ſenſibility of heart, before a genius can be formed equal to ſo difficult a taſk. Horace is indeed ſo ſenſible of the danger of introducing a new character in poetry, that he even diſcourages the attempt, and adviſes the poet rather to take his perſons from the ancient authors, or from tradition: *Ibid.* v. 119.—130.

To conceive the idea of a good man, and to invent and ſupport a great poetical character, are two very different things, however they may ſeem to have been confounded by ſome late critics. The firſt is eaſy to any perſon ſufficiently inſtructed in the duties of life: the laſt is perhaps of all the efforts of human genius the moſt difficult; ſo very difficult, that, though attempted by many, Homer, Shakeſpeare, and Milton, are almoſt the only authors who have ſucceeded in it. But characters of perfect virtue are not the moſt pro-

25 Which, though elevated, ſhould partake of the frailties of humanity;

per for poetry. It ſeems to be agreed, that the Deity ſhould not be introduced in the machinery of a poetical fable. To aſcribe to him words and actions of our own invention, ſeems very unbecoming; nor can a poetical deſcription, that is known to be, and muſt of neceſſity be, infinitely inadequate, ever ſatiſfy the human mind. Poetry, according to the beſt critics, is an imitation of human action; and therefore poetical characters, though elevated, ſhould ſtill partake of the paſſions and frailties of humanity. If it were not for the vices of ſome principal perſonages, the Iliad would not be either ſo intereſting or ſo moral: the moſt moving and moſt eventful parts of the Æneid are thoſe that deſcribe the effects of unlawful paſſion:—the moſt inſtructive tragedy in the world, we mean Macbeth, is founded in crimes of dreadful enormity:—and if Milton had not taken into his plan the fall of our firſt parents, as well as their ſtate of innocence, his divine poem muſt have wanted much of its pathos, and could not have been (what it now is) ſuch a treaſure of important knowledge, as no other uninſpired writer ever comprehended in ſo ſmall a compaſs.——Virtue, like truth, is uniform and unchangeable. We may anticipate the part a good man will act in any given circumſtances; and therefore the event that depends on ſuch a man muſt be leſs ſurpriſing than thoſe which proceed from paſſion; the viciſſitudes whereof it is frequently impoſſible to foreſee. From the violent temper of Achilles, in the Iliad, ſpring many great incidents; which could not have taken place, if he had been calm and prudent like Ulyſſus, or pious and patritotic like Eneas:—his rejection of Agamemnon's offers, in the ninth book, ariſes from the violence of his reſentment; his yielding to the requeſt of Patroclus, in the 16th, from the violence of his friendſhip (if we may ſo ſpeak) counteracting his reſentment; and his reſtoring to Priam the dead body of Hector, in the 24th, from the violence of his affection to his own aged father, and his regard to the command of Jupiter, counteracting, in ſome meaſure, both his ſorrow for his friend, and his thirſt for vengeance.——Beſides, except where there is ſome degree of vice, it pains us too exquiſitely to ſee misfortune; and therefore poetry would ceaſe to have a pleaſurable influence over our tender paſſions, if it were to exhibit virtuous characters only. And as in life, evil is neceſſary to our moral probation, and the poſſibility of error to our intellectual improvement; ſo bad or mixed characters are uſeful in poetry, to give to the good ſuch oppoſition, as puts them upon diſplaying and exerciſing their virtue.

26 Whilſt the perſonages in whoſe fate the poet means that we ſhould be intereſted ought to have good and great qualities.

All thoſe perſonages, however, in whoſe fortune the poet means that we ſhould be intereſted, muſt have agreeable and admirable qualities to recommend them to our regard. And perhaps the greateſt difficulty in the art lies in ſuitably blending thoſe faults which the poet finds it expedient to give to any particular hero, with ſuch moral, intellectual, or coporeal accompliſhments, as may engage our eſteem, pity, or admiration, without weakening our hatred of vice, or love of virtue. In moſt of our novels, and in many of our plays, it happens unluckily, that the hero of the piece is ſo captivating, as to incline us to be indulgent to every part of his character, the bad as well as the good. But a great maſter knows how to give the proper direction to human ſenſibility; and, without any perverſion of our faculties, or any confuſion of right and wrong, to make the ſame perſon the object of very different emotions, of pity and hatred, of admiration and horror. Who does not eſteem and admire Macbeth for his courage and generoſity? who does not pity him when beſet with all the terrors of a pregnant imagination, ſuperſtitious temper, and awakened conſcience? who does not abhor him as a monſter of cruelty, treachery and ingratitude? His good qualities, by drawing us near to him, make us, as it were, eye-witneſſes of his crime, and give us a fellow-feeling of his remorſe; and therefore, his example cannot fail to have a powerful effect in cheriſhing our love of virtue, and fortifying our minds againſt criminal impreſſions: whereas, had he wanted thoſe good qualities, we ſhould have kept aloof from his concerns, or viewed them with a ſuperficial attention; in which caſe his example would have had little more weight than that of the robber, of whom we know nothing, but that he was tried, condemned, and executed. Satan, in Paradiſe Loſt, is a character drawn and ſupported with the moſt conſummate judgement. The old furies and demons, Hecate, Tiſiphone, Alecto, Megara, are objects of unmixed and unmitigated abhorrence; Tityus, Enceladus, and their brethern, are remarkable for nothing but impiety, deformity, and vaſtneſs of ſize; Pluto is, at beſt an inſipid perſonage; Mars, a hair-brained ruffian; Taſſo's infernal tyrant, an ugly and overgrown monſter: But in the Miltonic Satan, we are forced to admire the majeſty of the ruined arch-angel, at the ſame time that we deteſt the unconquerable depravity of the fiend. "But, of all poetical characters, (ſays the elegant critic from whom we are extracting), the Achilles of Homer (D) ſeems to me the moſt exquiſite of invention, and the moſt highly finiſhed. The utility of this character in a moral view is obvious; for it may be conſidered as the ſource of all the morality of the Iliad. Had not the generous and violent temper of Achilles determined him to patroniſe the augur Chalcas in defiance of Agamemnon, and afterwards, on being affronted by that vindictive commander, to abandon for a time the common cauſe of Greece;—the fatal effects of diſſenſion among confederates, and of capricious and tyrannical behaviour in a ſovereign, would not have been the leading moral of Homer's

Beattie's Eſſays.

(D) "I ſay the *Achilles of Homer*. Latter authors have degraded the character of this hero, by ſuppoſing every part of his body invulnerable except the heel. I know not how often I have heard this urged as one of Homer's abſurdities; and indeed the whole Iliad is one continued abſurdity, on this ſuppoſition. But Homer all along makes his hero equally liable to wounds and death with other men. Nay, to prevent all miſtakes in regard to this matter, (if thoſe who cavil at the poet would but read his work), he actually wounds him in the right arm by the lance of Aſteropæus, in the battle near the river Scamander." See *Iliad*, xxi. ver. 161.—168.

Homer's poetry; nor could Hector, Sarpedon, Eneas, Ulyſſes, and the other amiable heroes, have been brought forward to ſignalize their virtues, and to recommend themſelves to the eſteem and imitation of mankind.

27 The excellence of the poetical character of Achilles, and

"They who form their judgment of Achilles from the imperfect ſketch given of him by Horace in the *Art of Poetry*, (v. 121, 122.); and conſider him only as a hateful compoſition of anger, revenge, fierceneſs, obſtinacy, and pride, can never enter into the views of Homer, nor be ſuitably affected with his narration. All theſe vices are no doubt, in ſome degree, combined in Achilles; but they are tempered with qualities of a different ſort, which render him a moſt intereſting character, and of courſe make the Iliad a moſt intereſting poem. Every reader abhors the faults of this hero: and yet, to an attentive reader of Homer, this hero muſt be the object of eſteem, admiration, and pity; for he has many good as well as bad affections, and is equally violent in all: Nor is he poſſeſſed of a ſingle vice or virtue, which the wonderful art of the poet has not made ſubſervient to the deſign of the poem, and to the progreſs and cataſtrophe of the action; ſo that the hero of the Iliad, conſidered as a poetical perſonage, is juſt what he ſhould be, neither greater nor leſs, neither worſe nor better.—He is every-where diſtinguiſhed by an abhorrence of oppreſſion, by a liberal and elevated mind, by a paſſion for glory, and by a love of truth, freedom, and ſincerity. He is for the moſt part attentive to the duties of religion; and, except to thoſe who have injured him, courteous and kind: he is affectionate to his tutor Phenix; and not only pities the misfortunes of his enemy Priam, but in the moſt ſoothing manner adminiſters to him the beſt conſolation that Homer's poor theology could furniſh. Though no admirer of the cauſe in which his evil deſtiny compels him to engage, he is warmly attached to his native land; and, ardent as he is in vengeance, he is equally ſo in love to his aged father Peleus, and to his friend Patroclus. He is not luxurious like Paris, nor clowniſh like Ajax; his accompliſhments are princely, and his amuſements worthy of a hero. Add to this, as an apology for the vehemence of his anger, that the affront he had received was (according to the manners of that age) of the moſt atrocious nature; and not only unprovoked, but ſuch as, on the part of Agamemnon, betrayed a brutal inſenſibility to merit, as well as a proud, ſelfiſh, ungrateful, and tyrannical diſpoſition. And though he is often inexcuſably furious; yet it is but juſtice to remark, that he was not naturally cruel (E); and that his wildeſt outrages were ſuch as in thoſe rude times might be expected from a violent man of invincible ſtrength and valour, when exaſperated by injury, and frantic with ſorrow.——Our hero's claim to the admiration of mankind is indiſputable. Every part of his character is ſublime and aſtoniſhing. In his perſon, he is the ſtrongeſt, the ſwifteſt, the moſt beautiful of men:—this laſt circumſtance, however, occurs not to his own obſervation, being too trivial to attract the notice of ſo great a mind. The Fates had put it in his power, either to return home before the end of the war, or to remain at Troy:—if he choſe the former, he would enjoy tranquillity and happineſs in his own country to a good old age; if the latter, he muſt periſh in the bloom of his youth:—his affection to his father and native country, and his hatred to Agamemnon, ſtrongly urged him to the firſt; but a deſire to avenge the death of his friend determines him to accept the laſt, with all its conſequences. This at once diſplays the greatneſs of his fortitude, the warmth of his friendſhip, and the violence of his ſanguinary paſſions: and it is this that ſo often and ſo powerfully recommends him to the pity, as well as admiration, of the attentive reader."

28 Of all Homer's characters.

It is equally a proof of rich invention and exact judgment in Homer, that he mixes ſome good qualities in all his bad characters, and ſome degree of imperfection in almoſt all his good ones.——Agamemnon, notwithſtanding his pride, is an able general, and a valiant man, and highly eſteemed as ſuch by the greater part of the army.——Paris, though effeminate, and vain of his dreſs and perſon, is, however, good-natured, patient of reproof, not deſtitute of courage, and eminently ſkilled in muſic and other fine arts.——Ajax is a huge giant; fearleſs rather from inſenſibility to danger, and confidence in his maſſy arms, than from any nobler principle; boaſtful and rough; regardleſs of the gods, though not downright impious: yet there is in his manner ſomething of frankneſs and blunt ſincerity, which entitle him to a ſhare in our eſteem; and he is ever ready to aſſiſt his countrymen, to whom he renders good ſervice on many a perilous emergency.——The character of Helen, in ſpite of her faults, and of the many calamities whereof ſhe is the guilty cauſe, Homer has found means to recommend to our pity, and almoſt to our love; and this he does, without ſeeking to extenuate the crime of Paris, of which the moſt reſpectable perſonages in the poem are made to ſpeak with becoming abhorrence. She is ſo full of remorſe, ſo ready on every occaſion to condemn her paſt conduct, ſo affectionate to her friends, ſo willing to do juſtice to every body's merit, and withal ſo finely accompliſhed, that ſhe extorts our admiration, as well as that of the Trojan ſenators.——Menelaus, though ſufficiently ſenſible of the injury he had received, is yet a man of moderation, clemency, and good-nature, a valiant ſoldier, and a moſt affectionate brother: but there is a daſh of vanity in his compoſition, and he entertains rather too high an opinion of his own abilities, yet never overlooks nor undervalues the merit of others.——Priam would claim unreſerved eſteem, as well as pity, if it were not for his inexcuſeable weakneſs, in gratifying the humour, and by indulgence abetting the crimes, of the moſt worthleſs of all his children, to the utter ruin of his people, family, and kingdom. Madame Dacier ſuppoſes, that he had loſt his authority, and was obliged to fall in with the politics of the times: but of this there appears no evidence;

Beattie, ut ſupra,

(E) See *Iliad* xxi. 100. and xxiv. 485.—673——In the firſt of theſe paſſages, Achilles himſelf declares, that before Patroclus was ſlain, he often ſpared the lives of his enemies, and took pleaſure in doing it. It is ſtrange, as Dr Beattie obſerves, that this ſhould be left out in Pope's Tranſlation.

evidence; on the contrary, he and his unworthy favourite Paris ſeem to have been the only perſons of diſtinction in Troy who were averſe to the reſtoring of Helen. Priam's foible (if it can be called by ſo ſoft a name), however faulty, is not uncommon, and has often produced calamity both in private and public life. The Scripture gives a memorable inſtance in the hiſtory of the good old Eli.——Sarpedon comes nearer a perfect character than any other of Homer's heroes; but the part he has to act is ſhort. It is a character which one could hardly have expected in thoſe rude times: a ſovereign prince, who conſiders himſelf as a magiſtrate ſet up by the people for the public good, and therefore bound in honour and gratitude to be himſelf their example, and ſtudy to excel as much in virtue as in rank and authority.——Hector is the favourite of every reader, and with good reaſon. To the trueſt valour he joins the moſt generous patriotiſm. He abominates the crime of Paris: but not being able to prevent the war, he thinks it his duty to defend his country, and his father and ſovereign, to the laſt. He too, as well as Achilles, foreſees his own death; which heightens our compaſſion, and raiſes our idea of his magnanimity. In all the relations of private life, as a ſon, a father, a huſband, a brother, he is amiable in the higheſt degree; and he is diſtinguiſhed among all the heroes for tenderneſs of affection, gentleneſs of manners, and a pious regard to the duties of religion. One circumſtance of his character, ſtrongly expreſſive of a great and delicate mind, we learn from Helen's lamentation over his dead body, that he was almoſt the only perſon in Troy who had always treated her with kindneſs, and never uttered one reproachful word to give her pain, nor heard others reproach her without blaming them for it. Some tendency to oſtentation (which, however, may be pardonable in a commander in chief), and temporary fits of timidity, are the only blemiſhes diſcoverable in this hero; whoſe portrait Homer appears to have drawn with an affectionate and peculiar attention.

By aſcribing ſo many amiable qualities to Hector and and ſome others of the Trojans, the poet intereſts us in the fate of that people, notwithſtanding our being continually kept in mind that they are the injurious party. And by thus blending good and evil, virtue and frailty, in the compoſition of his characters, he makes them the more conformable to the real appearances of human nature, and more uſeful as examples for our improvement; and at the ſame time without hurting veriſimilitude, gives every neceſſary embelliſhment to particular parts of his poem, and variety, coherence, and animation, to the whole fable. And it may alſo be obſerved, that though ſeveral of his characters are complex, not one of them is made up of incompatible parts: all are natural and probable, and ſuch as we think we have met with, or might have met with in our intercourſe with mankind.

29
Virgil fails in drawing characters.

From the ſame extenſive views of good and evil, in all their forms and combinations, Homer has been enabled to make each of his characters perfectly diſtinct in itſelf, and different from all the reſt; inſomuch, that before we come to the end of the Iliad, we are as well acquainted with his heroes, as with the faces and tempers of our moſt familiar friends. Virgil, by confining himſelf to a few general ideas of fidelity and fortitude, has made his ſubordinate heroes a very good ſort of people; but they are all the ſame, and we have no clear knowledge of any one of them. Acathes is faithful, and Gyas is brave, and Cloanthus is brave; and this is all we can ſay of the matter. We ſee theſe heroes at a diſtance, and have ſome notion of their ſhape and ſize; but are not near enough to diſtinguiſh their features; and every face ſeems to exhibit the ſame faint and ambiguous appearance. But of Homer's heroes we know every particular that can be known. We eat, and drink, and talk, and fight, with them: we ſee them in action and out of it; in the field and in their tents and houſes: the very face of the country about Troy we ſeem to be as well acquainted with as if we had been there. Similar characters there are among theſe heroes, as there are ſimilar faces in every ſociety; but we never miſtake one for another. Neſtor and Ulyſſes are both wiſe and both eloquent: but the wiſdom of the former ſeems to be the effect of experience; that of the latter of genius: the eloquence of the one is ſweet and copious, but not always to the purpoſe, and apt to degenerate into ſtory-telling; that of the other is cloſe, emphatical, and perſuaſive, and accompanied with a peculiar modeſty and ſimplicity of manner. Homer's heroes are all valiant; yet each diſplays a modification of valour peculiar to himſelf; one is valiant from principle, another from conſtitution; one is raſh, another cautious; one is impetuous and headſtrong, another impetuous, but tractable; one is cruel, another merciful; one is inſolent and oſtentatious, another gentle and unaſſuming; one is vain of his perſon another of his ſtrength, and a third of his family.——It would be tedious to give a complete enumeration. Almoſt every ſpecies of the heroic character is to be found in Homer.

Of the agents in Paradiſe Loſt, it has been obſerved*, that "the weakeſt are the higheſt and nobleſt of human beings, the original parents of mankind; with thoſe actions the elements conſented; on whoſe rectitude or deviation of will depended the ſtate of terreſtrial nature, and the condition of all the future inhabitants of the globe. Of the other agents in the poem, the chief are ſuch as it is irreverence to name on ſlight occaſions: the reſt are lower powers;

30
The difficulty of drawing and diſcriminating the characters in Paradiſe Loſt.

——Of which the leaſt could wield
Theſe elements, and arm him with the force
Of all the regions:

Powers, which only the controul of Omnipotence reſtrains from laying creation waſte, and filling the vaſt expanſe of ſpace with ruin and confuſion. To diſplay the motives and actions of beings thus ſuperior, ſo far as human reaſon can examine, or human imagination repreſent them, is the taſk which Milton undertook and performed. The characters in the Paradiſe Loſt, which admit of examination, are thoſe of angels and of men: of angels good and evil; of man in his innocent and ſinful ſtate.

31
Milton's ſucceſs in this part of his undertaking.

"Among the angels, the virtue of Raphael is mild and placid, of eaſy condeſcenſion, and free communication: that of Michael is regal and lofty, attentive to the dignity of his own nature. Abdiel and Gabriel appear occaſionally, and act as every incident requires: the ſolitary fidelity of Abdiel is very amiably painted.

"Of the evil angels, the characters are more diverſified. To Satan ſuch ſentiments are given as ſuit the moſt exalted and moſt depraved being. Milton has been cenſured for the impiety which ſometimes breaks from Satan's mouth; for there are thoughts, it is juſtly remarked, which no obſervation of character can juſtify; becauſe no good man would willingly permit them to paſs, however tranſiently, through his mind. This cenſure has been ſhown to be groundleſs by the great critic from whom we quote. To make Satan ſpeak as a rebel, ſays he, without any ſuch expreſſions as might taint the reader's imagination, was indeed one of the great difficulties in Milton's undertaking; and I cannot but think that he has extricated himſelf with great happineſs. There is in Satan's ſpeeches little that can give pain to a pious ear. The language of rebellion cannot be the ſame with that of obedience: the malignity of Satan foams in haughtineſs and obſtinacy, but his expreſſions are commonly general, and no otherwiſe offenſive than as they are wicked.—The other chiefs of the celeſtial rebellion are very judiciouſly diſcriminated; and the ferocious character of Moloch appears, both in the battle and in the council, with exact conſiſtency.

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* Johnſon's Life of Milton.

“ To Adam and to Eve are given, during their innocence, ſuch ſentiments as innocence can generate and utter. Their love is pure benevolence and mutual veneration; their repaſts are without luxury, and their diligence without toil. Their addreſſes to their Maker have little more than the voice of admiration and gratitude; fruition left them nothing to aſk, and innocence left them nothing to fear. But with guilt enter diſtruſt and diſcord, mutual accuſation and ſtubborn ſelf-defence: they regard each other with alienated minds, and dread their Creator as the avenger of their tranſgreſſion; at laſt, they ſeek ſhelter in his mercy, ſoften to repentance, and melt in ſupplication. Both before and after the fall, the different ſentiments ariſing from difference of ſex are traced out with inimitable delicacy and philoſophical propriety. Adam has always that pre-eminence in dignity, and Eve in lovelineſs, which we ſhould naturally look for in the father and mother of mankind.

32 Poetry according to nature improved to that degree which is conſiſtent with probability.

From what has been ſaid, it ſeems abundantly evident, —That the end of poetry is to pleaſe; and therefore that the moſt perfect poetry muſt be the moſt pleaſing; —that what is unnatural cannot give pleaſure; and therefore that poetry muſt be according to nature:— that it muſt be either according to real nature, or according to nature ſomewhat different from the reality —that, if according to real nature, it would give no greater pleaſure than hiſtory, which is a tranſcript of real nature;—that greater pleaſure is, however to be expected from it, becauſe we grant it ſuperior indulgence, in regard to fiction, and the choice of words;— and, conſequently, that poetry muſt be, not according to real nature, but according to nature improved to that degree which is conſiſtent with probability and ſuitable to the poet's purpoſe.——And hence it is that we call poetry, *An imitation of nature.*—For that which is properly termed *imitation* has always in it ſomething which is not in the original. If the prototype and tranſcript be exactly alike; if there be nothing in the one which is not in the other; we may call the latter a *repreſentation*, a *copy*, a *draught* or a *picture*, of the former; but we never call it an *imitation*.

SECT. V. *Of Arrangement, Unity, Digreſſions.* —*Further remarks on Nature in Poetry.*

33 How a poem ought to begin.

I. The origin of nations, and the beginnings of great events, are little known, and ſeldom intereſting; whence the firſt part of every hiſtory, compared with the ſequel, is ſomewhat dry and tedious. But a poet muſt, even in the beginning of his work, intereſt the readers, and raiſe high expectation; not by any affected pomp of ſtyle, far leſs by ample promiſes or bold profeſſions; but by ſetting immediately before them ſome incident, ſtriking enough to raiſe curioſity, in regard both to its cauſes and to its conſequences. He muſt therefore take up his ſtory, not at the beginning, but in the middle; or rather, to prevent the work from being too long, as near the end as poſſible; and afterwards take ſome proper opportunity to inform us of the preceding events, in the way of narrative, or by converſation of the perſons introduced, or by ſhort and natural digreſſions.

The action of both the *Iliad* and *Odyſſey* begins about ſix weeks before its concluſion; although the principal events of the war of Troy are to be found in the former; and the adventures of a ten years voyage, followed by the ſuppreſſion of a dangerous domeſtic enemy, in the latter. One of the firſt things mentioned by Homer in the Iliad, is a plague which Apollo in anger ſent into the Grecian army commanded by Agamemnon and now encamped before Troy. Who this Agamemnon was, and who the Grecians were; for what reaſon they had come hither; how long the ſiege had laſted; what memorable actions had been already performed; and in what condition both parties now were:—all this, and much more, we ſoon learn from occaſional hints and converſations interſperſed through the poem.

In the *Æneid*, which, though it comprehends the tranſactions of ſeven years, opens within a few months of the concluding event, we are firſt preſented with a view of the Trojan fleet at ſea, and no leſs a perſon than Juno intereſting herſelf to raiſe a ſtorm for their deſtruction. This excites a curioſity to know ſomething further: who theſe Trojans were, whence they had come, and whither they were bound; why they had left their own country, and what had befallen them ſince they left it. On all theſe points, the poet, without quitting the track of his narrative, ſoon gives the fulleſt information: the ſtorm riſes; the Trojans are driven to Africa, and hoſpitably received by the queen of the country; at whoſe deſire their commander relates his adventures.

The action of *Paradiſe Loſt* commences not many days before Adam and Eve are expelled from the garden of Eden, which is the concluding event. This poem, as its plan is incomparably more ſublime and more important than that of either the Iliad or Æneid, opens with a far more intereſting ſcene: a multitude of angels and archangels ſhut up in a region of torment and darkneſs, and rolling on a lake of unquenchable fire. Who theſe angels are, and what brought them into this miſerable condition, we naturally wiſh to know; and the poet in due time informs us; partly from the converſation of the fiends themſelves; and more particularly by the mouth of a happy ſpirit, ſent from heaven to caution the father and mother of mankind againſt temptation, and confirm their good reſolutions by unfolding the dreadful effects of impiety and diſobedience.

Beattie, ut ſupra.

34 The advantages of the poetical arrangement.

This poetical arrangement of events, ſo different from the hiſtorical, has other advantages beſides thoſe ariſing from brevity and compactneſs of detail: it is obviouſly more affecting to the fancy, and more alarming to the paſſions; and, being more ſuitable to the order and the manner in which the actions of other men ſtrikes our ſenſes is a more exact imitation of human affairs. I hear a ſudden noiſe in the ſtreet, and run to ſee what is the matter. An inſurrection has happened, a great multitude is brought together and ſomething very important is going forward. The ſcene before me is the firſt thing that engages my attention; and is in itſelf ſo intereſting, that for a moment or two I look at it in ſilence and wonder. By and by, when I get time for reflection, I begin to inquire into the cauſe of all this tumult, and what it is the people would be at; and one who is better informed than I, explains the affair from the beginning; or perhaps I make this out for myſelf, from the words and actions of the perſons principally concerned.—This is a ſort of picture or poetical arrangement, both in epic and dramatic compoſition; and this plan has been followed in narrative odes and ballads both ancient and modern.—The hiſtorian purſues a different method. He begins perhaps with an account of the manners of a certain age, and of the political conſtitution of a certain country; then introduces a particular perſon, gives the ſtory of his birth, connections, private character, purſuits, diſappointments, and of the events that promoted his views, and brought him acquainted with other turbulent ſpirits like himſelf; and ſo proceeds, unfolding, according to the order of time, the cauſes, principles, and progreſs of the conſpiracy, if that be the ſubject which he undertakes to illuſtrate. It cannot be denied, that this latter method is more favourable to calm information: but the former, compared with it, will be found to have all the advantages already ſpecified, and to be more effectually productive of that mental pleaſure which depends on the paſſions and imagination.

35 Unity of deſign neceſſary to the higher poetry.

II. If a work have no determinate end, it has no meaning; and if it have many ends, it will diſtract by its multiplicity. Unity of deſign, therefore belongs in ſome meaſure to all compoſitions, whether in verſe or proſe. But to ſome it is more eſſential than to others; and to none ſo much as in the higher poetry. In certain kinds of hiſtory, there is unity ſufficient if all the events recorded be referred to one perſon; in others, if to one period of time, or to one people, or even to the inhabitants of one and the ſame planet. But it is not enough that the ſubject of a poetical fable be the exploits of one perſon; for theſe may be of various and even of oppoſite ſorts and tendencies, and take up longer time than the nature of poetry can admit:—far leſs can a regular poem comprehend the affairs of one period or of one people:—it muſt be limited to one great action or event, to the illuſtration of which all the ſubordinate events muſt contribute; and theſe muſt be ſo connected with one another, as well as with the poet's general purpoſe, that one cannot be changed, tranſpoſed, or taken away, without affecting the conſiſtence and ſtability of the whole*. In itſelf an incident may be intereſting, a character well drawn, a deſcription beautiful; and yet, if it disfigure the general plan, or if it obſtruct or incumber the main action, inſtead of helping it forward, a correct artiſt would conſider it but as a gaudy ſuperfluity or ſplendid deformity; like a piece of ſcarlet cloth ſowed upon a garment of a different colour†. Not that all the parts of the fable either are, or can be, equally eſſential. Many deſcriptions and thoughts, of little conſequence to the plan, may be admitted for the ſake of variety; and the poet may, as well as the hiſtorian and philoſopher, drop his ſubject for a time, in order to take up an affecting or inſtructive digreſſion.

36 The propriety of digreſſions and epiſodes depends upon

III. The doctrine of poetical digreſſions and epiſodes has been largely treated by the critics. We ſhall here only remark, that, in eſtimating their propriety, three things are to be attended to:—their connection with the fable or ſubject; their own peculiar excellence; and their ſubſerviency to the poet's deſign.

37 Their connection with the ſubject of the poem,

(1.) Thoſe digreſſions that both ariſe from and terminate in the ſubject, like the epiſode of the angel Raphael in Paradiſe Loſt, and the tranſition to the death of Cæſar and the civil wars in the firſt book of the Georgic, are the moſt artful, and if ſuitably executed claim the higheſt praiſe:—thoſe that ariſe from, but do not terminate in, the ſubject, are perhaps ſecond in the order of merit; like the ſtory of Dido in the Æneid, and the encomium on a country life in the ſecond book of the Georgic:—thoſe come next that terminate in, but do not riſe from, the fable; of which there are ſeveral in the third book of the Æneid, and in the Odyſſey:——and thoſe that neither terminate in the fable nor riſe from it are the leaſt artful; and if they be long, cannot eſcape cenſure, unleſs their beauty be very great.

38 Their own peculiar excellence and

But (2.) we are willing to excuſe a beautiful epiſode at whatever expence to the ſubject it may be introduced. They who can blame Virgil for obtruding upon them the charming tale of Orpheus and Euridice in the fourth Georgic, or Milton for the apoſtrophe to light in the beginning of his third book, ought to forfeit all title to the peruſal of good poetry; for of ſuch divine ſtrains one would rather be the author than of all the books of criticiſm in the world. Yet ſtill it is better that an epiſode poſſeſs the beauty of connection, together with its own intrinſic elegance, than this without the other.

39 Their ſubſerviency to the poet's deſign.

Moreover, in judging of the propriety of epiſodes and other ſimilar contrivances, it may be expedient to attend (3.) to the deſign of the poet, as diſtinguiſhed from the fable or ſubject of the poem. The great deſign, for example, of Virgil, was to intereſt his countrymen in a poem written with a view to reconcile them to the perſon and government of Auguſtus. Whatever, therefore, in the poem tends to promote this deſign, even though it ſhould in ſome degree hurt the contexture of the fable, is really a proof of the poet's judgment; and may be not only allowed, but applauded.—The progreſs of the action of the Æneid may ſeem to be too long obſtructed in one place by the ſtory of Dido, which, though it riſes from the preceding part of the poem, has no influence upon the ſequel; and, in another, by the epiſode of Cacus, which, without injury to the fable, might have been omitted altogether. Yet theſe epiſodes, intereſting as they are to us and all mankind becauſe of the tranſcendent merit of the poetry, muſt have been ſtill more intereſting to the Romans becauſe of their connection with the Roman affairs; for the one accounts poetically for their wars with Carthage; and the other not only explains ſome of their religious ceremonies, but alſo gives a moſt charming rural picture of thoſe hills and valleys in the neighbourhod of the Tiber on which, in after times, their majeſtic city was fated to ſtand.—And if we conſider, that the deſign of Homer's Iliad was not only to ſhow the fatal effects of diſſenſion among confederates, but alſo to immortalize his country, and celebrate the moſt diſtinguiſhed families in it, we ſhall be inclined to think more favourably than critics generally do of ſome of his long ſpeeches and digreſſions; which, though to us they may ſeem trivial, muſt have been very intereſting to his countrymen on account of the genealogies and private hiſtory recorded in them.—Shakeſpeare's hiſtorical plays, conſidered as dramatic fables, and tried by the laws of tragedy and comedy, appear very rude compoſitions; but if we attend to the poet's deſign (as the elegant critic * has with equal truth and beauty explained it), we ſhall be forced to admire his judgment in the general conduct of thoſe pieces, as well as unequalled ſucceſs in the execution of particular parts.

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* Ariſt. Poet. § 8.

† Hor. Ar. Poet. v. 15. &c.

There is yet another point of view in which theſe digreſſions may be conſidered. If they tend to elucidate any important character, or to introduce any intereſting event not otherwiſe within the compaſs of the poem, or to give an amiable diſplay of any particular virtue, they may be entitled, not to our pardon only, but even to our admiration, however looſely they may hang upon the fable. All theſe three ends are effected by that moſt beautiful epiſode of Hector and Andromache in the ſixth book of the Iliad; and the two laſt, by the no leſs beautiful one of Euryalus and Niſus in the ninth of the Æneid.

IV. And now, from the poſition formerly eſtabliſhed, that the end of this divine art is to give pleaſure, it has been endeavoured to prove, that, whether in diſplaying the appearances of the material univerſe, or in imitating the workings of the human mind, and the varieties of human character, or in arranging and combining into one whole the ſeveral incidents and parts whereof his fable conſiſts,—the aim of the poet muſt be to copy nature, not as it is, but in that ſtate of perfection in which, conſiſtently with the particular genius of the work, and the laws of veriſimilitude, it may be ſuppoſed to be.

Such, in general, is the nature of that poetry which is intended to raiſe admiration, pity, and other ſerious emotions. But in this art, as in all others, there are different degrees of excellence; and we have hitherto directed our view chiefly to the higheſt. All ſerious poets are not equally ſolicitous to improve nature. Euripides is ſaid to have repreſented men as they were; Sophocles, more poetically, as they ſhould or might be †. Theocritus in his Idyls, and Spencer in his Shepherd's Calendar, give us language and ſentiments more nearly approaching thoſe of the *Rus verum et barbarum* ‡, than what we meet with in the Paſtorals of Virgil and Pope. In the hiſtorical drama, human characters and events muſt be according to hiſtorical truth, or at leaſt not ſo remote from it as to lead into any important miſapprehenſion of fact. And in the hiſtorical epic poem, ſuch as the Pharſalia of Lucan, and the Campaign of Addiſon, the hiſtorical arrangement is preferred to the poetical, as being nearer the truth. Yet nature is a little improved even in theſe poems. The perſons in Shakeſpeare's hiſtorical plays, and the heroes of the Pharſalia, talk in verſe, and ſuitably to their characters, and with a readineſs, beauty, and harmony of expreſſion, not to be met with in real life, nor even in hiſtory: ſpeeches are invented, and, to heighten the deſcription, circumſtances added, with great latitude: real events are rendered more compact and more ſtrictly dependent upon one another; and fictitious ones brought in, to elucidate human characters and diverſify the narration.

40
Nature always to be improved by the poet, though

The more poetry improves nature, by copying after general ideas collected from extenſive obſervation, the more it partakes (according to Ariſtotle) of the nature of philoſophy; the greater ſtretch of fancy and of obſervation it requires in the artiſt, the better chance it has to be univerſally agreeable.

41
When poetry falls ſhort of this perfection it may have great merit in other reſpects.

Yet poetry, when it falls ſhort of this perfection, may have great merit as an inſtrument of both inſtruction and pleaſure. To moſt men, ſimple unadorned nature is, at certain times, and in certain compoſitions, more agreeable than the moſt elaborate improvements of art; as a plain ſhort period, without modulation, gives a pleaſing variety to a diſcourſe. Many ſuch portraits of ſimple nature there are in the ſubordinate parts both of Homer's and of Virgil's poetry: and an excellent effect they have in giving probability to the fiction, as well as in gratifying the reader's fancy with images diſtinct and lively, and eaſily comprehended. The hiſtorical plays of Shakeſpeare raiſe not our pity and terror to ſuch a height as Lear, Macbeth, or Othello; but they intereſt and inſtruct us greatly notwithſtanding. The rudeſt of the eclogues of Theocritus, or even of Spencer, have by ſome authors been extolled above thoſe of Virgil, becauſe more like real life. Nay, Corneille is known to have preferred the Pharſalia to the Æneid, perhaps from its being nearer the truth, or perhaps from the ſublime ſentiments of ſtoical morality ſo forcibly and ſo oſtentatiouſly diſplayed in it.

Poets may refine upon nature too much as well as too little; for affectation and ruſticity are equally remote from true elegance. The ſtyle and ſentiments of comedy ſhould no doubt be more correct and more pointed than thoſe of the moſt polite converſation: but to make every footman a wit, and every gentlemen and lady an epigrammatiſt, as Congreve has done, is an exceſſive and faulty refinement. The proper medium has been hit by Menander and Terence, by Shakeſpeare in his happier ſcenes, and by Garrick, Cumberland, and ſome others of late renown. To deſcribe the paſſion of love with as little delicacy as ſome men ſpeak of it would be unpardonable; but to transform it into mere Platonic adoration is to run into another extreme, leſs criminal indeed, but too remote from univerſal truth to be univerſally intereſting. To the former extreme Ovid inclines, and Petrarch and his imitators to the latter. Virgil has happily avoided both: but Milton has painted this paſſion as diſtinct from all others, with ſuch peculiar truth and beauty, that we cannot think Voltaire's encomium too high, when he ſays, that love in all other poetry ſeems a weakneſs, but in Paradiſe Loſt a virtue. There are many good ſtrokes of Nature in Ramſay's Gentle Shepherd; but the author's paſſion for the *rus verum* betrays him into ſome indelicacies: a cenſure that falls with greater weight upon Theocritus, who is often abſolutely indecent. The Italian paſtoral of Taſſo and Guarini, and the French of Fontenelle, run into the oppoſite extreme (though in ſome parts beautifully ſimple), and diſplay a ſyſtem of rural manners ſo quaint and affected as to outrage all probability. In fine, though mediocrity of execution in poetry be allowed to deſerve the doom pronounced upon it by Horace; yet it is true, notwithſtanding, that in this art, as in many other good things, the point of excellence lies in a middle between two extremes; and has been reached by thoſe only who ſought to improve nature as far as the genius of their work would permit, keeping at an equal diſtance from ruſticity on the one hand, and affected elegance on the other.

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* Eſſays on the writings and genius of Shakeſpeare, p. 55.

† Ariſt. Poet.

‡ Martial.

Sect. VI. *Of Poetical Language.*

42 Words in poetry to be choſen for their ſenſe and for their ſound.

Words in poetry are choſen, firſt, for their *ſenſe*; and, ſecondly, for their *ſound*. That the firſt of theſe grounds of choice is the more excellent nobody can deny. He who in literary matters prefers ſound to ſenſe is a fool. Yet ſound is to be attended to even in proſe, and in verſe demands particular attention. We ſhall conſider poetical language, firſt, as SIGNIFICANT; and, ſecondly, as SUSCEPTIBLE OF HARMONY.

§ 1. *Of Poetical Language conſidered as* SIGNIFICANT.

43 The language of poetry an imitation of the language of nature.

If, as it has been endeavoured to prove, poetry be imitative of nature, poetical fictions of real events, poetical images of real appearances in the viſible creation, and poetical perſonages of real human characters; it would ſeem to follow, that the *language of poetry* muſt be an imitation of the *language of nature*.

44 Improved as far as may be conſiſtent with probability, &c.

According to Dr Beattie*, that language is natural which is ſuited to the ſpeaker's condition, character, and circumſtances. And as, for the moſt part, the images and ſentiments of ſerious poetry are copied from the images and ſentiments, not of real, but of improved, nature; ſo the language of ſerious poetry muſt (as hinted already) be a tranſcript, not of the real language of nature, which is often diſſonant and rude, but of natural language improved as far as may be conſiſtent with probability, and with the ſuppoſed character of the ſpeaker. If this be not the caſe, if the language of poetry be ſuch only as we hear in converſation or read in hiſtory, it will, inſtead of delight, bring diſappointment: becauſe it will fall ſhort of what we expect from an art which is recommended rather by its pleaſurable qualities than by its intrinſic utility; and to which, in order to render it pleaſing, we grant higher privileges than to any other kind of literary compoſition, or any other mode of human language.

The next inquiry muſt therefore be, "What are thoſe improvements that peculiarly belong to the language of poetry?" And theſe may be comprehended under two heads; *poetical words, and tropes and figures*.

Art. I. Of Poetical Words.

45 All languages have words peculiar to poetry.

One mode of improvement peculiar to poetical diction reſults from the uſe of thoſe words and phraſes which, becauſe they rarely occur in proſe, and frequently in verſe, are by the grammarian and lexicographer termed *poetical*. In theſe ſome languages abound more than others; but no language is altogether without them, and perhaps no language can be ſo in which any number of good poems have been written: for poetry is better remembered than proſe, eſpecially by poetical authors, who will always be apt to imitate the phraſeology of thoſe they have been accuſtomed to read and admire; and thus, in the works of poets down through ſucceſſive generations, certain phraſes may have been conveyed, which, though originally perhaps in common uſe, are now confined to poetical compoſition. Proſe writers are not ſo apt to imitate one another, at leaſt in words and phraſes, both becauſe they do not ſo well remember one another's phraſeology, and alſo becauſe their language is leſs artificial, and muſt not, if they would make it eaſy and flowing (without which it cannot be elegant), depart eſſentially from the ſtyle of correct converſation. Poets, too, on account of the greater difficulty of their numbers, have, both in the choice and in the arrangement of words, a better claim to indulgence, and ſtand more in need of a diſcretionary power.

The language of Homer differs materially from what was written and ſpoken in Greece in the days of Socrates. It differs in the mode of inflection, it differs in the ſyntax, it differs even in the words: ſo that one might read Homer with eaſe who could not read Xenophon; or Xenophon, without being able to read Homer. Yet we cannot believe that Homer, or the firſt Greek poet who wrote in his ſtyle, would make choice of a dialect quite different from what was intelligible in his own time: for poets have in all ages written with a view to be read, and to be read with pleaſure; which they could not be if their diction were hard to be underſtood. It is more reaſonable to ſuppoſe that the language of Homer is according to ſome ancient dialect, which, though not perhaps in familiar uſe among the Greeks at the time he wrote, was however intelligible. From the Homeric to the Socratic age, a period had elapſed of no leſs than 400 years; during which the ſtyle both of diſcourſe and of writing muſt have undergone great alterations. Yet the Iliad continued the ſtandard of heroic poetry, and was conſidered as the very perfection of poetical language; notwithſtanding that ſome words in it were become ſo antiquated, or ſo ambiguous, that Ariſtotle himſelf ſeems to have been ſomewhat doubtful in regard to their meaning*. And if Chaucer's merit as a poet had been as great as Homer's, and the Engliſh tongue under Edward III. as perfect as the Greek was in the ſecond century after the Trojan war, the ſtyle of Chaucer would probably have been our model for poetical diction at this day; even as Petrarch, his cotemporary, is ſtill imitated by the beſt poets of Italy.

46 The poetical dialect different from that of proſe.

The rudeneſs of the ſtyle of Ennius has been imputed by the old critics to his having copied too cloſely the dialect of common life. But this appears to be a miſtake. For if we compare the fragments of that author with the comedies of Plautus, who flouriſhed in the ſame age, and whoſe language was certainly copied from that of common life, we ſhall be ſtruck with an air of antiquity in the former that is not in the latter. Ennius, no doubt, like moſt other ſublime poets, affected ſomething of the antique in his expreſſion: and many of his words and phraſes, not adopted by any proſe-writer now extant, are to be found in Lucretius and Virgil, and were by them tranſmitted to ſucceeding poets. Theſe form part of the Roman poetical dialect; which appears from the writings of Virgil, where we have it in perfection, to have been very copious. The ſtyle of this charming poet is indeed ſo different from proſe, and is altogether ſo peculiar, that it is perhaps impoſſible to analyſe it on the common principles of Latin grammar. And yet no author can be more perſpicuous or more expreſſive; notwithſtanding the frequency of Greciſm in his ſyntax, and his love of old words, which he, in the judgment of Quintilian, knew better than any other man how to improve into decoration*.

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* Eſſays, Part ii. chap. 1.

* Poetics, cap. 25.

The poetical dialect of modern Italy is ſo different from the proſaic, that perſons who can read the hiſtorians, and even ſpeak with tolerable fluency the language of that country, may yet find it difficult to conſtrue a page of Petrarch or Taſſo. Yet it is not probable, that Petrarch, whoſe works are a ſtandard of the Italian poetical diction †, made any material innovations in his native tongue. It is rather probable that he wrote it nearly as it was ſpoken in his time, that is, in the 14th century; omitting only harſh combinations, and taking that liberty which Homer probably, and Virgil certainly, took before him, of reviving ſuch old, but not obſolete expreſſions, as ſeemed peculiarly ſignificant and melodious; and poliſhing his ſtyle to that degree of elegance which human ſpeech, without becoming unnatural, may admit of, and which the genius of poetry, as an art ſubſervient to pleaſure, may be thought to require.

The French poetry in general is diſtinguiſhed from proſe rather by the rhyme and the meaſure, than by any old or uncommon phraſeology. Yet the French, on certain ſubjects, imitate the ſtyle of their old poets, of Marot in particular; and may therefore be ſaid to have ſomething of a poetical dialect, though far leſs extenſive than the Italian, or even than the Engliſh. And it may be preſumed, that in future ages they will have more of this dialect than they have at preſent. This may be inferred from the very uncommon merit of ſome of their late poets, particularly Boileau and La Fontaine, who, in their reſpective departments, will continue to be imitated, when the preſent modes of French proſe are greatly changed: an event that, for all the pains they take to preſerve their language, muſt inevitably happen, and whereof there are not wanting ſome preſages already.

The Engliſh poetical dialect is not characteriſed by any peculiarities of inflection, nor by any great latitude in the uſe of foreign idioms. More copious it is, however, than one would at firſt imagine; as may appear from the following ſpecimen and obſervations.

47
Phraſes in Engliſh poetry not uſual in proſe

(1.) A few Greek and Latin idioms are common in Engliſh poetry, which are ſeldom or never to be met with in proſe. QUENCHED OF HOPE. Shakeſpeare.—SHORN OF HIS BEAMS. Milton.—*Created thing* NOR VALUED HE NOR SHUN'D. Milton.—*'Tis thus we riot, while* WHO SOW IT STARVE. Pope.—*This day* BE BREAD AND PEACE MY LOT. Pope.—INTO WHAT PIT THOU SEE'ST FROM WHAT HEIGHT FALLEN. Milton. *He deceived the Mother of mankind.* WHAT TIME HIS PRIDE HAD CAST HIM *out of heaven.* Milton.——Some of theſe, with others to be found in Milton, ſeem to have been adopted for the ſake of brevity, which in the poetical tongue is indiſpenſable. For the ſame reaſon, perhaps the articles *a* and *the* are ſometimes omitted by our poets, though leſs frequently in ſerious than burleſque compoſition.——In Engliſh, the adjective generally goes before the ſubſtantive, the nominative before the verb, and the active verb before (what we call) the accuſative. Exceptions, however, to this rule, are not uncommon even in proſe. But in poetry they are more frequent. *Their homely joys, and* DESTINY OBSCURE. *Now fades the glimmering landſcape on the ſight; and all the air a ſolemn ſtillneſs holds.* In general, that verſification may be leſs difficult, and the cadence more uniformly pleaſing; and ſometimes, too, in order to give energy to expreſſion, or vivacity to an image;—the Engliſh poet is permitted to take much greater liberties than the proſe-writer, in arranging his words, and modulating his lines and periods. Examples may be ſeen in every page of Paradiſe Loſt.

(2.) Some of our poetical words take an additional ſyllable, that they may ſuit the verſe the better; as, *diſpart, diſtain, diſport, affright, enchain,* for part, ſtain, ſport, fright, chain. Others ſeem to be nothing elſe than common words made ſhorter, for the convenience of the verſifier. Such are, *auxiliar, ſublunar, trump, vale, part, clime, ſubmiſs, frolic, plain, drear, dread, helm, morn, mead, eve* and *even, gan, illume* and *illumine, ope, hoar, bide, ſwage, ſcape;* for auxiliary, ſublunary, trumpet, valley, depart, climate, ſubmiſſive, frolicſome, complain, dreary, dreadful, helmet, morning, meadow, evening, began or began to, illuminate, open, hoary, abide, aſſuage, eſcape.——Of ſome of theſe the ſhort form is the more ancient. In Scotland, *even, morn, bide, ſwage,* are ſtill in vulgar uſe; but *morn,* except when contradiſtinguiſhed to *even,* is ſynonymous, not with *morning* (as in the Engliſh poetical dialect), but with *morrow.*—The Latin poets, in a way ſomewhat ſimilar, and perhaps for a ſimilar reaſon, ſhortened *fundamentum, tutamentum, munimentum,* &c. into fundamen, tutamen, munimen.

(3.) Of the following words, which are now almoſt peculiar to poetry, the greater part are ancient, and were once no doubt in common uſe in England, as many of them ſtill are in Scotland. *Afield, amain, annoy* (a noun), *anon, aye* (ever), *beheſt, blithe, brand* (ſword), *bridal, carol, dame* (lady), *featly, fell* (an adjective), *gaude, gore, hoſt* (army), *lambkin, late* (of late), *lay* (poem), *lea, glade, gleam, hurl, lore, meed, oriſons, plod* (to travel laboriouſly), *ringlet, rue* (a verb), *ruth, ruthleſs, ſojourn* (a noun), *ſmite, ſpeed* (an active verb), *ſave* (except), *ſpray* (twig), *ſteed, ſtrain* (ſong), *ſtrand, ſwain, thrall, thrill, trail* (a verb), *troll, wail, welter, warble, wayward, woo, the while* (in the mean time), *yon, of yore.*

(4.) Theſe that follow are alſo poetical; but, ſo far as appears, were never in common uſe. *Appal, arrowy, attune, battailous, breezy, car* (chariot), *clarion, cates, courſer, darkling, flicker, floweret, emblaze, gairiſh, circlet, impearl, nightly, noiſeleſs, pinion* (wing), *ſhadowy, ſlumberous, ſtreamy, troublous, wilder* (a verb), *ſhrill* (a verb), *ſhook* (ſhaken), *madding, viewleſs.*—The following, too, derived from the Greek and Latin, ſeem peculiar to poetry. *Clang, clangor, choral, bland, boreal, dire, enſanguined, ire, ireful, lave* (to waſh), *nymph* (lady, girl), *orient, panoply, philomel, infuriate, jocund, radiant, rapt, redolent, refulgent, verdant, vernal, zephyr, zone* (girdle), *ſylvan, ſuffuſe.*

(5.) In moſt languages, the rapidity of pronunciation abbreviates ſome of the commoneſt words, or even joins two, or perhaps more, of them, into one; and ſome of thoſe abbreviated forms finds admiſſion into writing. The Engliſh language was quite disfigured by them in the end of the laſt century; but Swift, by his ſatire and example, brought them into diſrepute: and, though ſome of them be retained in converſation, as *don't, ſhan't, can't*, they are now avoided in ſolemn ſtyle; and by elegant writers in general, except where the colloquial dialect is imitated, as in comedy. *'Tis* and *'twas*, ſince the time of Shafteſbury, ſeem to have been daily loſing credit, at leaſt in proſe; but ſtill have a place in poetry, perhaps becauſe they contribute to conciſeneſs. *'Twas on a lofty vaſe's ſide.* Gray.—*'Tis true, 'tis certain, man, though dead, retains part of himſelf.* Pope. In verſe too, *over* may be ſhortened into *o'er*, (which is the Scotch, and probably was the old Engliſh, pronunciation): *never* into *ne'er*; and from *the* and *to*, when they go before a word beginning with a vowel, the final letter is ſometimes cut off. *O'er hills, o'er dales, o'er crags, o'er rocks they go.* Pope.—*Where'er ſhe turns, the Graces homage pay. And all that beauty, all that wealth e'er gave. Rich with the ſpoils of time did ne'er unroll.* Gray.—*T' alarm th' eternal midnight of the grave.*——Theſe abbreviations are now peculiar to the poetical tongue, but not neceſſary to it. They ſometimes promote brevity, and render verſification leſs difficult.

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* Inſtit. viii. 3. § 3.

† Vicende della literatura del Denina, cap. 4.

48 To be uſed ſparingly.

(6.) Thoſe words which are commonly called *compound epithets*, as *roſy-finger'd, roſy-boſom'd, many-twinkling, many-ſounding, moſs-grown, bright-eyed, ſtraw-built, ſpirit-ſtirring, incenſe-breathing, heaven-taught, love-whiſpering, lute-reſounding*, are alſo to be conſidered as part of our poetical dialect. It is true, we have compounded adjectives in familiar uſe, as *high-ſeaſoned, well-natured, ill-bred*, and innumerable others. But we ſpeak of thoſe that are leſs common, that ſeldom occur except in poetry, and of which in proſe the uſe would appear affected. And that they ſometimes promote brevity and vivacity of expreſſion, cannot be denied. But as they give, when too frequent, a ſtiff and finical air to a performance; as they are not always explicit in the ſenſe, nor agreeable in the ſound; as they are apt to produce a confuſion, or too great a multiplicity, of images; as they tend to disfigure the language, and furniſh a pretext for endleſs innovation; they ought to be uſed ſparingly; and thoſe only uſed which the practice of popular authors has rendered familiar to the ear, and which are in themſelves peculiarly emphatical and harmonious.

(7.) In the transformation of nouns into verbs and participles, our poetical dialect admits of greater latitude than proſe. Hymn, pillow, curtain, ſtory, pillar, picture, peal, ſurge, cavern, honey, career, cincture, boſom, ſphere, are common nouns; but *to hymn, to pillow, curtained, pillared, pictured, pealing, ſurging, cavern'd, honied, careering, cinctured, boſomed, ſphered*, would appear affected in proſe, and yet in verſe they are warranted by great authorities, though it muſt be confeſſed that they are cenſured by an able critic *, who had ſtudied the Engliſh language, both poetical and proſaic, with wonderful diligence.

Some late poets, particularly the imitators of Spencer, have introduced a great variety of uncommon words, as certes, eftſoons, ne, whilom, tranſmew, moil, ſone, loſel, albe, hight, dight, pight, thews, couthful, aſſot, muchel, wend, arrear, &c. Theſe were once poetical words, no doubt; but they are now obſolete, and to many readers unintelligible. No man of the preſent age, however converſant in this dialect, would naturally expreſs himſelf in it on any intereſting emergence; or, ſuppoſing this natural to the antiquarian, it would never appear ſo to the common hearer or reader. A mixture of theſe words, therefore, muſt ruin the pathos of modern language; and as they are not familiar to our ear, and plainly appear to be ſought after and affected, will generally give a ſtiffneſs to modern verſification. Yet in ſubjects approaching to the ludicrous they may have a good effect; as in the *Schoolmiſtreſs* of Shenſtone, Parnel's Fairy-tale, Thomſon's Caſtle of Indolence, and Pope's lines in the Dunciad upon Wormius. But this effect will be moſt pleaſing to thoſe who have leaſt occaſion to recur to the gloſſary.

Indeed, it is not always eaſy to fix the boundary between poetical and obſolete expreſſions. To many readers, *lore, meed, beheſt, blithe, gaude, ſpray, thrall*, may already appear antiquated; and to ſome the ſtyle of Spencer, or even of Chaucer, may be as intelligible as that of Dryden. This however we may venture to affirm, that a word, which the majority of readers cannot underſtand without a gloſſary, may with reaſon be conſidered as obſolete; and ought not to be uſed in modern compoſition, unleſs revived, and recommended to the public ear, by ſome very eminent writer. There are but few words in Milton, as *nathleſs, tine, frore, boſky*, &c.; there are but one or two in Dryden, as *falſify* (F): and in Pope, there are none at all, which every reader of our poetry may not be ſuppoſed to underſtand: whereas in Shakeſpeare there are many, and in Spencer many more, for which one who knows Engliſh very well may be obliged to conſult the dictionary. The practice of Milton, Dryden, or Pope, may therefore, in almoſt all caſes, be admitted as good authority for the uſe of a poetical word. And in them, all the words above enumerated, as poetical, and in preſent uſe, may actually be found. And of ſuch poets as may chooſe to obſerve this rule, it will not be ſaid, either that they reject the judgment of Quintilian, who recommends the neweſt of the old words, and the oldeſt of the new, or that they are inattentive to Pope's precept;

> Be not the firſt by whom the new are tried,
> Nor yet the laſt to lay the old aſide.
>
> *Eſſ. on Crit.* v. 335.

We muſt not ſuppoſe that theſe poetical words never occur at all except in poetry. Even from converſation they are not excluded: and the ancient critics allow, that they may be admitted into proſe, where they occaſionally confer dignity upon a ſublime ſubject, or heighten the ludicrous qualities of a mean one. But it is in poetry only where the frequent uſe of them does not ſavour of affectation.

Nor muſt we ſuppoſe them eſſential to this art. Many

* Johnſon.

(F) Dryden in one place (Æneid ix. verſ. 1095.) uſes *Falſified* to denote *Pierced through and through*. He acknowledges, that this uſe of the word is an innovation; and has nothing to plead for it but his own authority, and that *Falſare* in Italian ſometimes means the ſame thing.

Of Poetical Words.

Many paſſages there are of exquiſite poetry, wherein not a ſingle phraſe occurs that might not be uſed in proſe. In fact, the influence of theſe words in adorning Engliſh verſe is not very extenſive. Some influence however they have. They ſerve to render the poetical ſtyle, firſt, more melodious; and, ſecondly, more ſolemn.

49 In which caſe they may render the poetical ſtyle more melodious

Firſt, They render the poetical ſtyle more melodious, and more eaſily reducible into meaſure. Words of unwieldy ſize, or difficult pronunciation, are never uſed by correct poets, where they can be avoided: unleſs in their ſound they have ſomething imitative of the ſenſe. Homer's poetical inflections contribute wonderfully to the ſweetneſs of his numbers: and if the reader is pleaſed to look back to the ſpecimen above given of the Engliſh poetical dialect, he will find that the words are in general well-ſounding, and ſuch as may coaleſce with other words, without producing harſh combinations. Quintilian obſerves, that poets, for the ſake of their verſe, are indulged in many liberties, not granted to the orator, of lengthening, ſhortening, and dividing their words*:—and if the Greek and Roman poets claimed this indulgence from neceſſity, and obtained it, the Engliſh, thoſe of them eſpecially who write in rhyme, may claim it with better reaſon; as the words of their language are leſs muſical and far leſs ſuſceptible of variety in arrangement and ſyntax.

50 And ſolemn.

Secondly, Such poetical words as are known to be ancient have ſomething venerable in their appearance, and impart a ſolemnity to all around them. This remark is from Quintilian; who adds, that they give to a compoſition that caſt and colour of antiquity which in painting is ſo highly valued, but which art can never effectually imitate †. Poetical words that are either not ancient, or not known to be ſuch, have, however, a pleaſing effect from aſſociation. We are accuſtomed to meet with them in ſublime and elegant writing; and hence they come to acquire ſublimity and elegance: Even as the words we hear on familiar occaſions come to be accounted familiar; and as thoſe that take their riſe among pick-pockets, gamblers, and gypſies, are thought too indelicate to be uſed by any perſon of taſte or good manners. When one hears the following lines, which abound in poetical words,

> The breezy call of incenſe-breathing morn,
> The ſwallow twittering from the ſtraw-built ſhed,
> The cock's ſhrill clarion, or the echoing horn,
> No more ſhall rouſe them from their lowly bed:

—one is as ſenſible of the dignity of the language, as one would be of the vileneſs or vulgarity of that man's ſpeech, who ſhould prove his acquaintance with Bridewell, by interlarding his diſcourſe with ſuch terms as *mill-doll*, *queer cull*, or *nubling cheat* ‡; or who, in imitation of fops and gamblers, ſhould on the common occaſions of life, talk of being *beat hollow*, or *ſaving his diſtance* §. What gives dignity to perſons gives dignity to language. A man of this character is one who has borne important employments, been connected with honourable aſſociates, and never degraded himſelf by levity or immorality of conduct. Dignified phraſes are thoſe which have been uſed to expreſs elevated ſentiments, have always made their appearance in elegant compoſition, and have never been profaned by giving permanency or utterance to the paſſions of the vile, the giddy, or the worthleſs. And as by an active old age, the dignity of ſuch men is confirmed and heightened; ſo the dignity of ſuch words, if they be not ſuffered to fall into diſuſe, ſeldom fails to improve by length of time.

Of Tropes and Figures.

Art. II. Of Tropes and Figures.

51 Tropes and figures neceſſary to poetical language,

If it appear that, by means of figures, language may be made more *pleaſing* and more natural than it would be without them; it will follow, that to poetic language, whoſe end is to *pleaſe* by imitating *nature*, figures muſt be not only ornamental, but neceſſary. It will here be proper, therefore, firſt to point out the importance and utility of figurative language; ſecondly, to ſhow, that figures are more neceſſary to poetry in general than to any other mode of writing.

I. *As to the importance and utility of figurative expreſſion*, in making language more pleaſing and more natural; it may be remarked,

52 To ſupply the defects of ſimple Language, and

(1.) That tropes and figures are often neceſſary to ſupply the unavoidable defects of language. When *proper* words are wanting, or not recollected, or when we do not chooſe to be always repeating them, we muſt have recourſe to tropes and figures. When philoſophers began to explain the operations of the mind, they found that moſt of the words in common uſe, being framed to anſwer the more obvious exigencies of life, were in their proper ſignification applicable to matter only and its qualities. What was to be done in this caſe? Would they think of making a new language to expreſs the qualities of mind? No: that would have been difficult or impracticable; and granting it both practicable and eaſy, they muſt have foreſeen, that nobody would read or liſten to what was thus ſpoken or written in a new and conſequently in an unknown tongue. They therefore took the language as they found it; and whereever they thought there was a ſimilarity or analogy between the qualities of the mind and the qualities of matter, ſcrupled not to uſe the names of the material qualities tropically, by applying them to the mental qualities. Hence came the phraſes *ſolidity* of judgment, *warmth* of imagination, *enlargement* of underſtanding, and many others; which, though figurative, expreſs the meaning juſt as well as proper words would have done. In fact, numerous as the words in every language are, they muſt always fall ſhort of the unbounded variety of human thoughts and perceptions. Taſtes and ſmells are almoſt as numerous as the ſpecies of bodies. Sounds admit of perceptible varieties that ſurpaſs all computation, and the ſeven primary colours may be diverſified without end. If each variety of external perception were to have a name, language would be inſurmountably difficult; nay, if men were to appropriate a claſs of names to each particular ſenſe, they would multiply words exceedingly, without adding any thing to the clearneſs of ſpeech. Thoſe words, therefore, that in their proper ſignification denote the objects of one ſenſe, we often apply tropically to the objects of another, and ſay, Sweet taſte, ſweet ſmell, ſweet ſound; ſharp point, ſharp taſte, ſharp ſound; harmony of ſounds, harmony of colours, harmony of parts; ſoft ſilk, ſoft colour, ſoft ſound, ſoft temper; and ſo in a thouſand inſtances: and yet theſe words, in their tropical ſignification, are not leſs intelligible than in their proper one; for ſharp taſte and ſharp ſound, are as expreſſive as ſharp ſword; and harmony of tones is not better underſtood by the muſician, than harmony of parts by the architect, and harmony of colours by the painter.

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* Inſtit. Orat. lib. 10. cap. 1. § 3.

† Lib. 8. cap. 3. § 3.

‡ See the Scoundrel's Dictionary.

§ Language of New-market.

Savages, illiterate perſons, and children, have comparatively but few words in proportion to the things they may have occaſion to ſpeak of; and muſt therefore recur to tropes and figures more frequently than perſons of copious elocution. A ſeaman, or mechanic, even when he talks of that which does not belong to his art, borrows his language from that which does; and this makes his diction figurative to a degree that is ſometimes entertaining enough. "Death (ſays a ſeaman in one of Smollet's novels) has not yet *boarded* my comrade; but they have been *yard-arm and yard-arm* theſe *three glaſſes*. His *ſtarboard* eye is open, but faſt *jammed* in his head; and the *haulyards* of his under jaw have given way." Theſe phraſes are exaggerated; but we allow them to be natural, becauſe we know that illiterate people are apt to make uſe of tropes and figures taken from their own trade, even when they ſpeak of things that are very remote and incongruous. In thoſe poems, therefore, that imitate the converſation of illiterate perſons, as in comedy, farce, and paſtoral, ſuch figures judiciouſly applied may render the imitation more pleaſing, becauſe more exact and natural.

53
To avoid harſhneſs of diction:

Words that are untuneable and harſh, the poet is often obliged to avoid, when perhaps he has no other way to expreſs their meaning than by tropes and figures; and ſometimes the meaſure of his verſe may oblige him to reject a proper word that is not harſh, merely on account of its being too long, or too ſhort, or in any other way unſuitable to the rhythm, or to the rhyme. And hence another uſe of figurative language, that it contributes to poetical harmony. Thus, *to preſs the plain*, is frequently uſed to ſignify *to be ſlain in battle; liquid plain* is put for *ocean*, *blue ſerene* for *ſky*, and *ſylvan reign* for *country life*.

54
Tropes and figures favourable to delicacy.

(2.) Tropes and figures are favourable to delicacy. When the proper name of a thing is in any reſpect unpleaſant, a well-choſen trope will convey the idea in ſuch a way as to give no offence. This is agreeable, and even neceſſary, in polite converſation, and cannot be diſpenſed with in elegant writing of any kind. Many words, from their being often applied to vulgar uſe, acquire a meanneſs that diſqualifies them for a place in ſerious poetry; while perhaps, under the influence of a different ſyſtem of manners, the correſponding words in another language may be elegant, or at leaſt not vulgar. When one reads Homer in the Greek, one takes no offence at his calling Eumeus by a name which, literally rendered, ſignifies *ſwine-herd*; firſt, becauſe the Greek word is well-ſounding in itſelf; ſecondly, becauſe we have never heard it pronounced in converſation, nor conſequently debaſed by vulgar uſe; and, thirdly, becauſe we know, that the office denoted by it was, in the age of Eumeus, both important and honourable. But Pope would have been blamed, if a name ſo indelicate as *ſwine-herd* had in his tranſlation been applied to ſo eminent a perſonage; and therefore he judiciouſly makes uſe of the trope *ſynecdoche*; and calls him *ſwain* *; a word both elegant and poetical, and not likely to lead the reader into any miſtake about the perſon ſpoken of, as his employment had been deſcribed in a preceding paſſage. The ſame Eumeus is ſaid, in the ſimple but melodious language of the original, to have been making his own ſhoes when Ulyſſes came to his door; a work which in thoſe days the greateſt heroes would often find neceſſary. This, too, the tranſlator ſoftens by a tropical expreſſions;

> Here ſat Eumeus, and his cares applied,
> To form ſtrong *buſkins* of well ſeaſoned hide.

A hundred other examples might be quoted from this tranſlation; but theſe will explain our meaning.

There are other occaſions on which the delicacy of figurative language is ſtill more needful; as in Virgil's account of the effects of animal love, and of the plague among the beaſts, in the third Georgic; where Dryden's ſtyle, by being leſs figurative than the original, is in one place exceedingly filthy, and in another ſhockingly obſcene.

Hobbes could conſtrue a Greek author; but his ſkill in words muſt have been all derived from the dictionary: for he ſeems not to have known that any one articulate ſound could be more agreeable, or any one phraſe more dignified, than another. In his Iliad and Odyſſey, even when he hits the author's ſenſe (which is not always the caſe), he proves, by his choice of words, that of harmony, elegance, or energy of ſtyle, he had no manner of conception. And hence that work, though called a *Tranſlation of Homer*, does not even deſerve the name of *poem*; becauſe it is in every reſpect unpleaſing, being nothing more than a fictitious narrative delivered in a mean proſe, with the additional meanneſs of harſh rhyme and untuneable meaſure.——Trapp underſtood Virgil well enough as a grammarian, and had a taſte for his beauties; yet his tranſlation bears no reſemblance to Virgil; which is owing to the ſame cauſe, an imprudent choice of words and figures, and a total want of harmony.

55
Which, however, may be carried too far.

The delicacy we here contend for, may indeed, both in converſation and in writing be carried too far. To call *killing an innocent man in a duel* an affair of honour, and *a violation of the rights of wedlock* an affair of gallantry, is a proſtitution of figurative language. Nor is it any credit to us, that we are ſaid to have upwards of 40 figurative phraſes to denote exceſſive drinking. Language of this ſort generally implies, that the public abhorrence of ſuch crimes is not ſo ſtrong as it ought to be; and it is a queſtion, whether even our morals might not be improved, if we were to call theſe and ſuch like crimes by their proper names, *murder*, *adultery*, *drunkenneſs*, *gluttony*; names, that not only expreſs our meaning, but alſo betoken our diſapprobation.——As to writing, it cannot be denied, that even Pope himſelf, in the excellent verſion juſt now quoted, has ſometimes, for the ſake of his numbers, or for fear of giving offence by too cloſe an imitation of Homer's ſimplicity, employed tropes or figures too quaint or too ſolemn for the occaſion. And the finical ſtyle is in part characteriſed by the writer's diſlike to literal expreſſions, and affectedly ſubſtituting in their ſtead unneceſſary tropes and figures. With theſe authors, a man's only child muſt alway be his *only hope*; a country maid becomes *a rural beauty*, or perhaps a *nymph of the groves*; if flattery ſing at all, it muſt be a *ſyren ſong*; the ſhepherd's flute dwindles into an *oaten reed*, and his crook is exalted into a *ſceptre*; the *ſilver lilies* riſe from their *golden beds*, and *languiſh* to the *complaining* gale. A young woman, though a good Chriſtian, cannot make herſelf agreeable without *ſacrificing to the Graces*; nor
hope

* Odyſſ. b. 14. v. 41.

hope to do any execution among the *gentle ſwains*, till a whole legion of *Cupids*, armed with *flames* and *darts*, and other weapons, begin to diſcharge from her eyes their formidable artillery. For the ſake of variety, or of the verſe, ſome of theſe figures may now and then find a place in a poem; but in proſe, unleſs very ſparingly uſed, they ſavour of affectation.

56 Tropes and figures promote brevity, and

(3.) Tropes and figures promote brevity; and brevity, united with perſpicuity, is always agreeable. An example or two will be given in the next paragraph. Sentiments thus delivered, and imagery thus painted, are readily apprehended by the mind, make a ſtrong impreſſion upon the fancy, and remain long in the memory; whereas too many words, even when the meaning is good, never fail to bring diſguſt and wearineſs. They argue a debility of mind which hinders the author from ſeeing his thoughts in one diſtinct point of view; and they alſo encourage a ſuſpicion, that there is ſomething faulty or defective in the matter. In the poetic ſtyle, therefore, which is addreſſed to the fancy and paſſions, and intended to make a vivid, a pleaſing, and a permanent impreſſion, brevity, and conſequently tropes and figures are indiſpenſable. And a language will always be the better ſuited to poetical purpoſes, the more it admits of this brevity;—a character which is more conſpicuous in the Greek and Latin than in any modern tongue, and much leſs in the French than in the Italian or Engliſh.

57 Contribute to ſtrength and energy of language.

(4.) Tropes and figures contribute to ſtrength or energy of language, not only by their conciſeneſs, but alſo by conveying to the fancy ideas that are eaſily comprehended, and make a ſtrong impreſſion. We are powerfully affected with what we ſee, or feel, or hear. When a ſentiment comes enforced or illuſtrated by figures taken from objects of ſight, or touch, or hearing, one thinks, as it were, that one ſees, or feels, or hears, the thing ſpoken of; and thus, what in itſelf would perhaps be obſcure, or is merely intellectual, may be made to ſeize our attention and intereſt our paſſions almoſt as effectually as if it were an object of outward ſenſe. When Virgil calls the Scipios *thunderbolts of war*, he very ſtrongly expreſſes in one word, and by one image, the rapidity of their victories, the noiſe their atchievements made in the world, and the ruin and conſternation that attended their irreſiſtible career.——When Homer calls Ajax *the bulwark of the Greeks*, he paints with equal brevity his vaſt ſize and ſtrength, the difficulty of prevailing againſt him, and the confidence wherewith his countrymen repoſed on his valour.——When Solomon ſays of the ſtrange woman, or harlot, that "her feet go *down* to death," he lets us know, not only that her path ends in deſtruction, but alſo, that they who accompany her will find it eaſy to go forwards to ruin, and difficult to return to their duty.——Satan's enormous magnitude, and refulgent appearance, his perpendicular aſcent through a region of darkneſs, and the inconceivable rapidity of his motion, are all painted out to our fancy by Milton, in one very ſhort ſimilitude,

> Sprung upward, like—a pyramid of fire.
> *Par. Loſt*, b. 4. v. 1013.

To take in the full meaning of which figure, we muſt imagine ourſelves in chaos, and a vaſt luminous body riſing upward, near the place where we are, ſo ſwiftly as to appear a continued track of light, and leſſening to the view according to the increaſe of diſtance, till it end in a point, and then diſappear; and all this muſt be ſuppoſed to ſtrike our eye in one inſtant.——Equal to this in propriety, though not in magnificence, is that allegory of Gray,

> The paths of glory lead but to the grave:

Which preſents to the imagination a wide plain, where ſeveral roads appear, crowded with glittering multitudes, and iſſuing from different quarters, but drawing nearer and nearer as they advance, till they terminate in the dark and narrow houſe, where all their glories enter in ſucceſſion, and diſappear for ever.——When it is ſaid in Scripture, of a good man who died, that he *fell aſleep*, what a number of ideas are at once conveyed to our imagination, by this beautiful and expreſſive figure: As a labourer, at the cloſe of day, goes to ſleep, with the ſatisfaction of having performed his work, and with the agreeable hope of awakening in the morning of a new day, refreſhed and cheerful; ſo a good man, at the end of life, reſigns himſelf calm and contented to the will of his Maker, with the ſweet reflection of having endeavoured to do his duty, and with the tranſporting hope of ſoon awaking in the regions of light, to life and happineſs eternal. The figure alſo ſuggeſts, that to a good man the tranſition from life to death is, even in the ſenſation no more painful, than when our faculties melt away into the pleaſing inſenſibility of ſleep.——Satan, flying among the ſtars, is ſaid by Milton to "*ſail* between worlds and worlds; which has an elegance and force far ſuperior to the proper word *fly*. For by this alluſion to a ſhip, we are made to form a lively idea of his great ſize, and to conceive of his motion, that it was equable and majeſtic.——Virgil uſes a happy figure to expreſs the ſize of the great wooden horſe, by means of which the Greeks were conveyed into Troy: "Equum divina Palladis arte *ædificant*."——Milton is ſtill bolder when he ſays,

> Who would not ſing for Licidas? he knew
> Himſelf to ſing, and *build the lofty rhyme*.

The phraſe, however, though bold, is emphatical; and gives a noble idea of the durability of poetry, as well as of the art and attention requiſite to form a good poem.——There are hundreds of tropical expreſſions in common uſe, incomparably more energetic than any proper words of equal brevity that could be put in their place. A cheek *burning* with bluſhes, is a trope which at once deſcribes the colour as it appears to the beholder, and the glowing heat as it is felt by the perſon bluſhing. *Chilled* with deſpondence, *petrified* with aſtoniſhment, *thunderſtruck* with diſagreeable and unexpected intelligence, *melted* with love or pity, *diſſolved* in luxury, *hardened* in wickedneſs, *ſoftening* into remorſe, *inflamed* with deſire, *toſſed* with uncertainty &c.—every one is ſenſible of the force of theſe and the like phraſes, and that they muſt contribute to the energy of compoſition.

58 They are likewiſe the language of ſtrong paſſion.

(5.) Tropes and figures promote ſtrength of expreſſion; and are in poetry peculiarly requiſite, becauſe they are often more *natural*, and more *imitative*, than proper words. In fact, this is ſo much the caſe, that it would be impoſſible to imitate the language of paſſion without them. It is true, that when the mind is agitated, one does not run out into allegories, or long-winded ſimilitudes, or any of the figures that require much attention and many words, or that tend to withdraw the fancy from the object of the paſſion. Yet the language of many paſſions muſt be figurative notwithſtanding; becauſe they rouſe the fancy, and direct it to objects congenial to their own nature, which diverſify the language of the ſpeaker with a multitude of alluſions. The fancy of a very angry man, for example, preſents to his view a train of diſagreeable ideas connected with the paſſion of anger, and tending to encourage it; and if he ſpeak without reſtraint during the paroxyſm of his rage, thoſe ideas will force themſelves upon him, and compel him to give them utterance. "Infernal monſter! (he will ſay),—my blood boils at him; he has uſed me like a dog; never was man ſo injured as I have been by this barbarian. He has no more ſenſe of propriety than a ſtone. His countenance is diabolical, and his ſoul as ugly as his countenance. His heart is cold and hard, and his reſolutions dark and bloody," &c. This ſpeech is wholly figurative. It is made up of *metaphors* and *hyperboles*, which, with the *proſopopœia* and *apoſtrophe*, are the moſt paſſionate of all the figures. Lear, driven out of doors by his unnatural daughters, in the midſt of darkneſs, thunder, and tempeſt, naturally breaks forth (for his indignation is juſt now raiſed to the very higheſt pitch) into the following violent exclamation againſt the crimes of mankind, in which almoſt every word is figurative.

Tremble, thou wretch,
That haſt within thee undivulged crimes
Unwhipt of juſtice. Hide thee, thou bloody hand,
Thou perjur'd, and thou ſimular of virtue,
That art inceſtuous. Caitiff, to pieces ſhake,
That under covert, and convenient ſeeming,
Haſt practis'd on man's life. Cloſe pent-up guilts,
Rive your concealing continents, and cry
Theſe dreadful ſummoners grace. *King Lear.*

——The vehemence of maternal love, and ſorrow from the apprehenſion of loſing her child, make the Lady Conſtance utter a language that is ſtrongly figurative, though quite ſuitable to the condition and character of the ſpeaker. The paſſage is too long for a quotation, but concludes thus:

O Lord! my boy, my Arthur, my fair ſon,
My life, my joy, my food, my all the world,
My widow-comfort, and my ſorrow's cure. *King John.*

——Similar to this, and equally expreſſive of conjugal love, is that beautiful hyperbole in Homer; where Andromache, to diſſuade her huſband from going out to the battle, tells him that ſhe had now no mother, father, or brethren, all her kindred being dead, and her native country deſolate; and then tenderly adds,

But while my Hector yet ſurvives, I ſee
My father, mother, brethren, all in thee. *Iliad*, b. 6.

59
The ſimpleſt language moſt ſuitable to depreſſing paſſions,

As the paſſions that agitate the ſoul, and rouſe the fancy, are apt to vent themſelves in tropes and figures, ſo thoſe that depreſs the mind adopt for the moſt part a plain diction without any ornament: for to a dejected mind, wherein the imagination is generally inactive, it is not probable that any great variety of ideas will preſent themſelves; and when theſe are few and familiar, the words that expreſs them muſt be ſimple. As no author equals Shakeſpeare in boldneſs or variety of figures when he copies the ſtyle of thoſe violent paſſions that ſtimulate the fancy; ſo, when he would exhibit the human mind in a dejected ſtate, no uninſpired writer excels him in ſimplicity. The ſame Lear whoſe reſentment had impaired his underſtanding, while it broke out in the moſt boiſterous language, when, after ſome medical applications, he recovers his reaſon, his rage being now exhauſted, his pride humbled, and his ſpirits totally depreſſed, ſpeaks in a ſtyle than which nothing can be imagined more ſimple or more affecting.

Pray, do not mock me:
I am a very fooliſh, fond old man,
Fourſcore and upward; and, to deal plainly with you,
I fear I am not in my perfect mind.
Methinks I ſhould know you, and know this man;
Yet I am doubtful: for I am mainly ignorant
What place this is; and all the ſkill I have
Remembers not theſe garments: nor I know not
Where I did lodge laſt night.——*Lear*, act 4. ſc. 7.

——Deſdemona, ever gentle, artleſs, and ſincere, ſhocked at the unkindneſs of her huſband, and overcome with melancholy, ſpeaks in a ſtyle ſo beautifully ſimple, and ſo perfectly natural, that one knows not what to ſay in commendation of it:

My mother had a maid call'd Barbara;
She was in love, and he ſhe lov'd prov'd mad,
And did forſake her. She had a ſong of willow;
An old thing it was, but it expreſs'd her fortune,
And ſhe died ſinging it. That ſong to-night
Will not go from my mind: I have much to do,
But to go hang my head all at one ſide,
And ſing it like poor Barbara. *Othello*, act 4. ſc. 3.

60
And to the ſentiment of admiration.

Sometimes the imagination, even when exerted to the utmoſt, takes in but few ideas. This happens when the attention is totally engroſſed by ſome very great object; admiration being one of thoſe emotions that rather ſuſpend the exerciſe of the faculties than puſh them into action. And here, too, the ſimpleſt language is the moſt natural; as when Milton ſays of the Deity, that he ſits "high-throned above all height." And as this ſimplicity is more ſuitable to that one great exertion which occupies the ſpeaker's mind than a more elaborate imagery or language would have been, ſo has it alſo a more powerful effect in fixing and elevating the imagination of the hearer; for to introduce other thoughts for the ſake of illuſtrating what cannot be illuſtrated, could anſwer no other purpoſe than to draw off the attention from the principal idea. In theſe and the like caſes, the fancy left to itſelf will have more ſatisfaction in purſuing at leiſure its own ſpeculations than in attending to thoſe of others; as they who ſee for the firſt time ſome admirable object would chooſe rather to feaſt upon it in ſilence, than to have their thoughts interrupted by a long deſcription from another perſon, informing them of nothing but what they ſee before them, are already acquainted with, or may eaſily conceive.

It was remarked above, that the *hyperbole*, *proſopopœia*, and *apoſtrophe*, are among the moſt paſſionate figures. This deſerves illuſtration.

61
Hyberbole natural to the paſſions of anger love, fear, in &c.

1ſt, A very angry man is apt to think the injury he has juſt received greater than it really is; and if he proceed immediately to retaliate by word or deed, ſeldom fails to exceed the due bounds, and to become injurious in his turn. The fond parent looks upon his child as a prodigy of genius and beauty; and the romantic lover will not be perſuaded that his miſtreſs has nothing ſupernatural either in her mind or perſon. Fear, in like manner, not only magnifies its object when real, but even forms an object out of nothing and miſtakes the fictions of fancy for the imitations of ſenſe.—No wonder, then, that they who ſpeak according to the impulſe of paſſion ſhould ſpeak *hyperbolically*; that the angry man ſhould exaggerate the injury he has received, and the vengeance he is going to inflict; that the ſorrowful ſhould magnify what they have loſt, and the joyful what they have obtained; that the lover ſhould ſpeak extravagantly of the beauty of his miſtreſs, the coward of the dangers he has encountered, and the credulous clown of the miracles performed by the juggler. In fact, theſe people would not do juſtice to what they feel if they did not ſay more than the truth. The valiant man, on the other hand, as naturally adopts the diminiſhing hyperbole when he ſpeaks of danger; and the man of ſenſe, when he is obliged to mention his own virtue or ability; becauſe it appears to him, or he is willing to conſider it, as leſs than the truth, or at beſt as inconſiderable. Contempt uſes the ſame figure; and therefore Petruchio, affecting that paſſion, affects alſo the language of it.

> Thou lieſt, thou thread, thou thimble,
> Thou yard, three-quarters, half-yard, quarter, nail,
> Thou flea, thou nit, thou winter-cricket, thou!
> Brav'd in mine own houſe with a ſkein of thread!
> Away, thou rag, thou quantity, thou remnant!
> *Taming of the Shrew*, act 4. ſc. 1.

For ſome paſſions conſider their objects as important, and others as unimportant. Of the former ſort are anger, love, fear, admiration, joy, ſorrow, pride; of the latter are contempt and courage. Thoſe may be ſaid to ſubdue the mind to the object, and theſe to ſubdue the object to the mind. And the former, when violent, always magnify their objects; whence the hyperbole called amplification, or *auxeſis*: and the latter as conſtantly diminiſh theirs; and give riſe to the hyperbole called *meioſis*, or diminution.—Even when the mind cannot be ſaid to be under the influence of any violent paſſion, we naturally employ the ſame figure when we would impreſs another very ſtrongly with any idea. "He is a walking ſhadow; he is worn to ſkin and bone; he has one foot in the grave and the other following:"—theſe, and the like phraſes, are proved to be natural by their frequency. By introducing great ideas, the hyperbole is further uſeful in poetry as a ſource of the ſublime; but when employed injudiciouſly is very apt to become ridiculous. Cowley makes Goliah as big as the hill down which he was marching †; and tells us, that when he came into the valley he ſeemed to fill it, and to overtop the neighbouring mountains (which, by the by, ſeems rather to leſſen the mountains and valleys than to magnify the giant); nay, he adds that the ſun ſtarted back when he ſaw the ſplendour of his arms. This poet ſeems to have thought that the figure in queſtion could never be ſufficiently enormous: but Quintilian would have taught him, "Quamvis omnis hyperbole ultra fidem, non tamen eſſe debet ultra modum." The reaſon is, that this figure, when exceſſive, betokens rather abſolute infatuation than intenſe emotion; and reſembles the efforts of a ranting tragedian, or the ravings of an enthuſiaſtic declaimer, who, by putting on the geſtures and looks of a lunatic, ſatisfy the diſcerning part of their audience, that, inſtead of feeling ſtrongly, they have no rational feelings at all. In the wildeſt energies of nature there is a modeſty which the imitative artiſt will be careful never to overſtep.

62
Proſopopœia when proper.

2*dly*, That figure, by which things are ſpoken of as if they were perſons, is called *proſopopœia*, or *perſonification*. It is a bold figure, and yet is often natural. Long acquaintance recommends to ſome ſhare in our affection even things inanimate, as a houſe, a tree, a rock, a mountain, a country; and were we to leave ſuch a thing, without hope of return, we ſhould be inclined to addreſs it with a farewel, as if it were a percipient creature. Hence it was that Mary queen of Scotland, when on her return to her own kingdom, ſo affectionately bade adieu to the country which ſhe had left. "Farewel, France," ſaid ſhe; "farewel, beloved country, which I ſhall never more behold!" Nay, we find that ignorant nations have actually worſhipped ſuch things, or conſidered them as the haunt of certain powerful beings. Dryads and hamadryads were by the Greeks and Romans ſuppoſed to preſide over trees and groves; river gods and nymphs, over ſtreams and fountains; little deities, called *Lares* and *Penates*, were believed to be the guardians of hearths and houſes. In Scotland there is hardly a hill remarkable for the beauty of its ſhape, that was not in former times thought to be the habitation of fairies. Nay, modern as well as ancient ſuperſtition has appropriated the waters to a peculiar ſort of demon or goblin, and peopled the very regions of death, the tombs and charnel-houſes, with multitudes of ghoſts and phantoms.—Beſides, when things inanimate make a ſtrong impreſſion upon us, whether agreeable or otherwiſe, we are apt to addreſs them in terms of affection or diſlike. The ſailor bleſſes the plank that brought him aſhore from the ſhipwreck; and the paſſionate man, and ſometimes even the philoſopher, will ſay bitter words to the ſtumbling-block that gave him a fall.—Moreover a man agitated with any intereſting paſſion, eſpecially of long continuance, is apt to fancy that all nature ſympathiſes with him. If he has loſt a beloved friend, he thinks the ſun leſs bright than at other times; and in the ſighing of the winds and groves, in the lowings of the herd, and in the murmurs of the ſtream, he ſeems to hear the voice of lamentation. But when joy or hope predominate, the whole world aſſumes a gay appearance. In the contemplation of every part of nature, of every condition of mankind, of every form of human ſociety, the benevolent and the pious man, the moroſe and the cheerful, the miſer and the miſanthrope, finds occaſion to indulge his favourite paſſion, and ſees, or thinks he ſees, his own temper reflected back in the actions, ſympathies, and tendencies of other things and perſons. Our affections are indeed the medium through which we may be ſaid to ſurvey ourſelves, and every thing elſe; and whatever be our inward frame, we are apt to perceive a wonderful congeniality in the world without us. And hence the fancy, when rouſed by real emotions, or by the pathos of compoſition, is eaſily reconciled to thoſe figures of ſpeech that aſcribe ſympathy, perception and the other attributes of animal life, to things inanimate, or even to notions merely intellectual.—Motion too, bears a cloſe affinity to action, and affects our imagination nearly in the ſame manner; and we ſee a great part of nature in motion, and by its ſenſible effects are led to contemplate energies innumerable. Theſe conduct the rational mind to the Great Firſt Cauſe; and theſe, in times of ignorance, diſpoſed the vulgar to believe in a variety of ſubordinate agents employed in producing thoſe appearances that could not otherwiſe be accounted for. Hence an endleſs train of fabulous deities, and of witches, demons, fairies, genii; which, if they prove our reaſon weak and our fancy ſtrong, prove alſo that perſonification is natural to the human mind; and that a right uſe of this figure may have a powerful effect, in fabulous writing eſpecially, to engage our ſympathy in behalf of things as well as perſons: for nothing can give laſting delight to a moral being, but that which awakens ſympathy, and touches the heart; and though it be true that we ſympathiſe in ſome degree even with inanimate things, yet what has, or is ſuppoſed to have, life, calls forth a more ſincere and more permanent fellow-feeling. —Let it be obſerved further, that to awaken our ſympathetic feelings, a lively conception of their object is neceſſary. This indeed is true of almoſt all our emotions; their keenneſs is in proportion to the vivacity of the perceptions that excite them. Diſtreſs that we ſee is more affecting than what we only hear of *; a peruſal of the gayeſt ſcenes in a comedy does not rouſe the mind ſo effectually as the preſence of a cheerful companion; and the death of a friend is of greater energy in producing ſeriouſneſs, and the conſideration of our latter end, than all the pathos of Young. Of deſcriptions addreſſed to the fancy, thoſe that are moſt vivid and picturеſque will generally be found to have the moſt powerful influence over our affections; and thoſe that exhibit perſons engaged in action, and adorned with viſible inſignia, give a briſker impulſe to the faculties than ſuch as convey intellectual ideas only, or images taken from ſtill life. No abſtract notion of time or of love can be ſo ſtriking to the fancy as the image of an old man accoutred with a ſcythe, or of a beautiful boy with wings and a bow and arrows: and no phyſiological account of frenzy could ſuggeſt ſo vivid an idea as the poet has given us in that exquiſite portrait,

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† Davideis, b. 3.

And moody madneſs laughing wild amid ſevereſt wo.

And for this reaſon partly it is that the epic poet, in order to work the more effectually upon our paſſions and imagination, refers the ſecret ſprings of human conduct, and the viciſſitudes of human affairs, to the agency of perſonified cauſes; that is, to the machinery of gods and goddeſſes, angels, demons, magicians, and other powerful beings. And hence, in all ſublime poetry life and motion, with their ſeveral modes and attributes, are liberally beſtowed on thoſe objects wherewith the author intends that we ſhould be ſtrongly impreſſed ſcenes perfectly inanimate and ſtill, tending rather to diffuſe a languor over the mind than to communicate to our internal powers thoſe lively energies without which a being eſſentially active can never receive complete gratification.—Laſtly, ſome violent paſſions are peculiarly inclined to change things into perſons. The horrors of his mind haunted Oreſtes in the ſhape of furies. Conſcience, in the form of the murdered perſon, ſtares the murderer in the face, and often terrifies him to diſtraction. The ſuperſtitious man, travelling alone in the dark, miſtakes a white ſtone for a ghoſt, a buſh for a demon, a tree waving with the wind for an enormous giant brandiſhing a hundred arms. The lunatic and enthuſiaſt converſe with perſons who exiſt only in their own diſtempered fancy; and the glutton and the miſer, if they were to give utterance to all their thoughts, would often, it is preſumable, ſpeak, the one of his gold, the other of his belly, not only as a perſon, but as a god,—the object of his warmeſt love and moſt devout regard.—More need not be ſaid to prove that perſonification is natural, and may frequently contribute to the pathos, energy, and beauty of poetic language.

631
Apoſtrophe how to be uſed.

3dly, *Apoſtrophe*, or a ſudden diverſion of ſpeech from one perſon to another perſon or thing, is a figure nearly related to the former. Poets ſometimes make uſe of it, in order to help out their verſe, or merely to give variety to their ſtyle: but on theſe occaſions it is to be conſidered as rather a trick of art, than an effort of nature. It is moſt natural, and moſt pathetic, when the perſon or thing to whom the apoſtrophe is made, and for whoſe ſake we give a new direction to our ſpeech, is in our eyes eminently diſtinguiſhed for good or evil, or raiſes within us ſome ſudden and powerful emotion, ſuch as the hearer would acquieſce in, or at leaſt acknowledge to be reaſonable. But this, like the other pathetic figures, muſt be uſed with great prudence. For if, inſtead of calling forth the hearer's ſympathy, it ſhould only betray the levity of the ſpeaker, or ſuch wanderings of his mind as neither the ſubject nor the occaſion would lead one to expect, it will then create diſguſt inſtead of approbation. The orator, therefore, muſt not attempt the paſſionate apoſtrophe, till the minds of the hearers be prepared to join in it. And every audience is not equally obſequious in this reſpect. In the forum of ancient Rome that would have paſſed for ſublime and pathetic, which to the moſt reſpectable of our audiences would appear ridiculous. For our ſtyle of public ſpeaking is cool and argumentative; and partakes leſs of enthuſiaſm than the Roman did, and much leſs than the modern French or Italian. Of Britiſh eloquence, particularly that of the pulpit, the chief recommendations are gravity and ſimplicity. And it is vain to ſay, that our oratory *ought* to be more vehement: for that matter depends on cauſes, which it is not only inexpedient, but impoſſible to alter; namely, on the character and ſpirit of the people, and their rational notions in regard to religion, policy, and literature. The exclamations of Cicero would weigh but little in our Congreſs; and many of thoſe which we meet with in French ſermons would not be more effectual if attempted in our pulpit. To ſee one of our preachers, who the moment before was a cool reaſoner, a temperate ſpeaker, an humble Chriſtian, and an orthodox divine, break out into a ſudden apoſtrophe to the immortal powers, or to the walls of the church, tends to force a ſmile, rather than a tear, from thoſe among us who reflect, that there is nothing in the ſubject, and ſhould be nothing in the orator, to warrant ſuch wanderings of fancy or vehemence of emotion. If he be careful to cultivate a pure ſtyle, and a grave and graceful utterance, a clergyman, who ſpeaks from conviction the plain unaffected words of truth and ſoberneſs, of benevolence and piety, will, it is believed, convey more pathetic, as well as more permanent, impreſſions to the heart, and be more uſeful as a Chriſtian teacher, than if he were to put in practice all the attitudes of Roſcius, and all the tropes and figures of Cicero.

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* Hor. Ar. Poet. v. 180

But where the language of paſſion and enthuſiaſm is permitted to diſplay itſelf, whatever raiſes any ſtrong emotion, whether it be animated or inanimate, abſent or preſent, ſenſible or intellectual, may give riſe to the apoſtrophe. A man in a diſtant country, ſpeaking of the place of his birth, might naturally exclaim, "O my dear native land, ſhall I never ſee thee more!" Or, when ſome great misfortune befalls him, "Happy are ye, O my parents, that ye are not alive to ſee this." We have a beautiful apoſtrophe in the third book of the Æneid, where Æneas, who is telling his ſtory to Dido, happening to mention the death of his father, makes a ſudden addreſs to him as follows:

——— hic pelagi tot tempeſtatibus actus,
Heu, genitorem, omnis curæ caſuſque levamen,
Amitto Anchiſen:—hic me, pater optime, feſſum
Deſeris, heu, tantis, nequicquam erepte periclis!

This apoſtrophe has a pleaſing effect. It ſeems to intimate, that the love which the hero bore his father was ſo great, that when he mentioned him he forgot every thing elſe; and, without minding his company, one of whom was a queen, ſuddenly addreſſed himſelf to that which, though preſent only in idea, was ſtill a principal object of his affection. An emotion ſo warm and ſo reaſonable cannot fail to command the ſympathy of the reader.——When Michael, in the eleventh book of Paradiſe Loſt, announces to Adam and Eve the neceſſity of their immediate departure from the garden of Eden, the poet's art in preſerving the decorum of the two characters is very remarkable. Pierced to the heart at the thought of leaving that happy place, Eve, in all the violence of ungovernable ſorrow, breaks forth into a pathetic apoſtrophe to Paradiſe, to the flowers ſhe had reared, and to the nuptial bower ſhe had adorned. Adam makes no addreſs to the walks, the trees, or the flowers of the garden, the loſs whereof did not ſo much afflict him; but, in his reply to the archangel, expreſſes, without a figure, his regret for being baniſhed from a place where he had been ſo oft honoured with a ſenſible manifeſtation of the divine preſence. The uſe of the apoſtrophe in the one caſe, and the omiſſion of it in the other, not only gives a beautiful variety to the ſtyle, but alſo marks that ſuperior elevation and compoſure of mind, by which the poet had all along diſtinguiſhed the character of Adam.—One of the fineſt applications of this figure that is anywhere to be ſeen, is in the fourth book of the ſame poem; where the author, catching by ſympathy the devotion of our firſt parents, ſuddenly drops his narrative, and joins his voice to theirs in adoring the Father of the univerſe.

Thus at their ſhady lodge arriv'd, both ſtood,
Both turn'd, and under open ſky ador'd
The God that made both ſky, air, earth, and heav'n,
Which they beheld, the moon's reſplendent globe,
And ſtarry pole:—Thou alſo mad'ſt the night,
Maker omnipotent! and thou the day,
Which we in our appointed work employ'd
Have finiſh'd.————

Milton took the hint of this fine contrivance from a well-known paſſage of Virgil:

Hic juvenum chorus, ille ſenum; qui carmine laudes
Herculeas et facta ferant;————
———— ut duros mille labores
Rege ſub Euryſtheo, fatis Junonis iniquæ,
Pertulerit:—Tu nubigenas, invicte, bimembres,
Hylæum Pholumque, manu; tu Creſia mactas
Prodigia.————

The beauty ariſing from diverſified compoſition is the ſame in both, and very great in each. But every reader muſt *feel*, that the figure is incomparably more affecting to the mind in the imitation than in the original. So true it is, that the moſt rational emotions raiſe the moſt intenſe fellow-feeling; and that the apoſtrophe is then the moſt emphatical, when it diſplays thoſe workings of human affection which are at once ardent and well-founded.

64 Tropes and figures are uſeful, as they ſuggeſt an endleſs variety of agreeable images.

To conclude this head: Tropes and figures, particularly the *metaphor*, *ſimilitude*, and *allegory*, are further uſeful, in beautifying language, by ſuggeſting, together with the thoughts eſſential to the ſubject, an endleſs variety of agreeable images, for which there would be no place, if writers were always to confine themſelves to the *proper* names of things. And this beauty and variety, judiciouſly applied, is ſo far from diſtracting, that it tends rather to fix, the attention, and captivate the heart of the readers, by giving light, and life, and pathos, to the whole compoſition.

II. That tropes and figures are more neceſſary to poetry, than to any other mode of writing, was the ſecond point propoſed to be illuſtrated in this ſection.

65 Tropes and figures more neceſſary to poetry than to any other mode of writing.

Language, as already obſerved, is then natural, when it is ſuitable to the ſuppoſed condition of the ſpeaker. Figurative language is peculiarly ſuitable to the ſuppoſed condition of the poet; becauſe figures are ſuggeſted by the fancy; and the fancy of him who compoſes poetry is more employed than that of any other author. Of all hiſtorical, philoſophical, and theological reſearches, the object is *real* truth, which is fixed and permanent. The aim of rhetorical declamation (according to Cicero) is *apparent* truth, which, being leſs determinate, leaves the fancy of the ſpeaker more free, gives greater ſcope to the inventive powers, and ſupplies the materials of a more figurative phraſeology. But the poet is ſubject to no reſtraints, but thoſe of veriſimilitude; which is ſtill leſs determinate than rhetorical truth. He ſeeks not to convince the judgment of his reader by arguments of either real or apparent cogency; he means only to pleaſe and intereſt him, by an appeal to his ſenſibility and imagination. His own imagination is therefore continually at work, ranging through the whole of real and probable exiſtence, "glancing from heaven to earth, from earth to heaven," in queſt of images and ideas ſuited to the emotions he himſelf feels, and to the ſympathies he would communicate to others. And, conſequently, figures of ſpeech, the offspring of excurſive fancy, muſt, (if he ſpeak according to what he is ſuppoſed to think and feel, that is, according to his ſuppoſed condition) tincture the language of the poet more than that of any other compoſer. So that, if figurative diction be unnatural in geometry, becauſe all wanderings of fancy are unſuitable, and even impoſſible, to the geometrician, while intent upon his argument; it is, upon the ſame principle, perfectly

fectly natural, and even unavoidable, in poetry; becauſe the more a poet attends to his ſubject, and the better qualified he is to do it juſtice, the more active will his imagination be, and the more diverſified the ideas that preſent themſelves to his mind.——Beſides, the true poet addreſſes himſelf to the paſſions and ſympathies of mankind; which, till his own be raiſed, he cannot hope to do with ſucceſs. And it is the nature of many paſſions, though not of all, to increaſe the activity of imagination: and an active imagination naturally vents itſelf in figurative language; nay, unleſs reſtrained by a correct taſte, has a tendency to exceed in it; of which Biſhop Taylor and Lord Verulam, two genuiſes different in kind, but of the higheſt order, are memorable examples.

We ſaid, that "the poet ſeeks not to convince the judgment of his reader by arguments of either real or apparent cogency."——We do not mean, that in poetry argument has no place. The moſt legitimate reaſoning the ſoundeſt philoſophy, and narratives purely hiſtorical may appear in a poem, and contribute greatly to the honour of the author, and to the importance of his work. All this we have in Paradiſe Loſt.—We mean, that what diſtinguiſhes *pure* poetry from other writing, is its aptitude, not to ſway the judgment by reaſoning, but to pleaſe the fancy, and move the paſſions, by a lively imitation of nature. Nor would we exclude poetical embelliſhment from hiſtory, or even from philoſophy. Plato's Dialogues and the Moral Eſſays of Addiſon and Johnſon abound in poetic imagery; and Livy and Tacitus often amuſe their readers with poetical deſcription. In like manner, though geometry and phyſics be different ſciences; though abſtract ideas be the ſubject, and pure demonſtration or intuition the evidence, of the former; and though the material univerſe, and the informations of ſenſe, be the ſubject and the evidence of the latter; yet have theſe ſciences been united by the beſt philoſophers, and very happy effects reſulted from the union.——In one and the ſame work, poetry, hiſtory, philoſophy, and oratory, may doubtleſs be blended; nay, theſe arts have all been actually blended in one and the ſame work, not by Milton only, but alſo by Homer, Virgil, Lucan, and Shakeſpeare. Yet ſtill theſe arts are different; different in their ends and principles, and in the faculties of the mind to which they are reſpectively addreſſed: and it is eaſy to perceive when a writer employs one and when another.

§ 2. *Of the* SOUND *of Poetical Language.*

66 The poet ought to attend to the harmony of language, which conſiſts in

As the ear, like every other perceptive faculty, is capable of gratification, regard is to be had to the ſound of words, even in proſe. But to the harmony of language, it behoves the poet, more than any other writer, to attend; as it is more eſpecially his concern to render his work pleaſurable. In fact, we find, that no poet was ever popular who did not poſſeſs the art of harmonious compoſition.

What belongs to the ſubject of Poetical Harmony may be referred to one or other of theſe heads, *Sweetneſs*, *Meaſure*, and *Imitation*.

67 Sweetneſs and

I. In order to give *ſweetneſs* to language, either in verſe or proſe, all words of harſh ſound, difficult pronunciation, or unwieldy magnitude, are to be avoided as much as poſſible, unleſs when they have in the ſound ſomething peculiarly emphatical; and words are to be ſo placed in reſpect of one another, as that diſcordant combinations may not reſult from their union. But in poetry this is more neceſſary than in proſe; poetical language being underſtood to be an imitation of natural language improved to that perfection which is conſiſtent with probability. To poetry, therefore, a greater latitude muſt be allowed than to proſe, in expreſſing, by tropes and figures of pleaſing ſound, thoſe ideas whereof the proper names are in any reſpect offenſive, either to the ear or to the fancy.

II. How far verſification or *regular meaſure* may be eſſential to this art, has been diſputed by critical writers; ſome holding it to be indiſpenſably neceſſary, and ſome not neceſſary at all.

68 Meaſure, which, though not eſſential,

The fact ſeems to be as already hinted, that to poetry verſe is not eſſential. In a proſe work, we may have the fable, the arrangement, and a great deal of the pathos and language, of poetry; and ſuch a work is certainly a poem, though perhaps not a perfect one. For how abſurd would it be to ſay, that by changing the poſition only of a word or two in each line, one might diveſt Homer's Iliad of the poetical character! At this rate, the arts of poetry and verſification would be the ſame; and the rules in Deſpauter's Grammer, and the moral diſtichs aſcribed to Cato, would be as real poetry as any part of Virgil. In fact, ſome very ancient poems, when tranſlated into a modern tongue, are far leſs poetical in verſe than in proſe; the alterations neceſſary to adapt them to our numbers being detrimental to their ſublime ſimplicity; of which any perſon of taſte will be ſenſible, who compares our common proſe-verſion of Job, the Pſalms, and the Song of Solomon, with the beſt metrical paraphraſe of thoſe books that has yet appeared. Nay, in many caſes, Comedy will be more poetical, becauſe more pleaſing and natural, in proſe than in verſe. By verſifying Tom Jones, and The Merry Wives of Windſor, we ſhould ſpoil the two fineſt comic poems, the one epic, the other dramatical, now in the world.

69 Adds to the perfection of poetry.

But, ſecondly, though verſe be not eſſential to poetry it is neceſſary to the perfection of all poetry that admits of it. Verſe is to poetry, what colours are to painting (G). A painter might diſplay great genius, and draw maſterly figures with chalk or ink; but if he intend a perfect picture, he muſt employ in his work as many colours as are ſeen in the object he imitates. Or, to adopt a beautiful compariſon of Demoſthenes, quoted by Ariſtotle *, "Verſification is to poetry what bloom is to the human countenance." A good face is agreeable when the bloom is gone, and good poetry may pleaſe without verſification; harmonious numbers may ſet

* Rhetor. lib. 3. cap. 4.

(G) Horace ſeems to hint at the ſame compariſon, when, after ſpecifying the ſeveral ſorts of verſe ſuitable to Epic, Elegiac, Lyric, and Dramatic Poetry, he adds,

Deſcriptas ſervare vices, *operumque colores*.
Cur ego, ſi nequeo ignoroque, Poeta ſalutor? *Ar. Poet.* ver. 86.

ſet off an indifferent poem, and a fine bloom indifferent features: but, without verſe, poetry is incomplete; and beauty is not perfect, unleſs to ſweetneſs and regularity of feature there be ſuperadded,

> The bloom of young deſire, and purple light of love.

If numbers are neceſſary to the perfection of the higher poetry, they are no leſs ſo to that of the lower kinds, to Paſtoral, Song, and Satire, which have little beſides the language and verſification to diſtinguiſh them from proſe; and which ſome ancient authors are unwilling to admit to the rank of poems: though it ſeems too nice a ſcruple, both becauſe ſuch writings are commonly termed *poetical;* and alſo becauſe there is, even in them, ſomething that may not improperly be conſidered as an imitation of nature.

That the rhythm and meaſures of verſe are naturally agreeable, and therefore that by theſe poetry may be made more pleaſing than it would be without them, is evident from this, that children and illiterate people, whoſe admiration we cannot ſuppoſe to be the effect of habit or prejudice, are exceedingly delighted with them. In many proverbial ſayings, where there is neither rhime nor alliteration, rhythm is obviouſly ſtudied. Nay, the uſe of rhythm in poetry is univerſal; whereas alliteration and rhime, though reliſhed by ſome nations, are not much ſought after by others. And we need not be at a loſs to account for the agreeableneſs of proportion and order, if we reflect, that they ſuggeſt the agreeable ideas of contrivance and ſkill, at the ſame time that they render the connection of things obvious to the underſtanding, and imprint it deeply on the memory. Verſe by promoting diſtinct and eaſy remembrance, conveys ideas to the mind with energy, and enlivens every emotion the poet intends to raiſe in the reader or hearer. Beſides, when we attend to verſes, after hearing one or two, we become acquainted with the meaſure, which therefore we always look for in the ſequel. This perpetual interchange of hope and gratification is a ſource of delight; and to this in part is owing the pleaſure we take in the rhimes of modern poetry. And hence we ſee, that though an incorrect rhime or untuneable verſe be in itſelf, and compared with an important ſentiment, a very trifling matter; yet it is no trifle in regard to its effects on the hearer; becauſe it brings diſappointment, and ſo gives a temporary ſhock to the mind, and interrupts the current of the affections; and becauſe it ſuggeſts the diſagreeable ideas of negligence or want of ſkill on the part of the author. And therefore, as the public ear becomes more delicate, the negligence will be more glaring, and the diſappointment more intenſely felt; and correctneſs of rhime and of meaſure will of courſe be the more indiſpenſable. In our tongue, rhime is more neceſſary to Lyric than to Heroic poetry. The reaſon ſeems to be, that in the latter the ear can of itſelf perceive the boundary of the meaſure, becauſe the lines are all of equal length nearly, and every good reader makes a ſhort pauſe at the end of each; whereas, in the former, the lines vary in length: and therefore the rhime is requiſite to make the meaſure and rhythm ſufficiently perceptible. Cuſtom too may have ſome influence. Engliſh Odes without rhime are uncommon; and therefore have ſomething awkward about them, or ſomething at leaſt to which the public ear is not yet thoroughly reconciled. Indeed, when the drama is excepted, we do not think that rhime can be ſafely ſpared from Engliſh poetry of any kind, but when the ſubject is able to ſupport itſelf. "He that thinks himſelf capable of aſtoniſhing (ſays Johnſon) may write blank verſe; but thoſe that hope only to pleaſe, muſt condeſcend to rhime."

70
In what caſes rhime may be diſpenſed with in Engliſh poetry.

Rhime, however, is of leſs importance by far than rhythm, which in poetry as well as in muſic is the ſource of much pleaſing variety; of variety tempered with uniformity, and regulated by art; inſomuch that, notwithſtanding the likeneſs of one hexameter verſe to another, it is not common, even in Virgil or in Homer, to meet with two contiguous hexameters whoſe rhythm is exactly the ſame. And though all Engliſh heroic verſes conſiſt of five feet, among which the iambic predominates; yet this meaſure, in reſpect of rythm alone, is ſuſceptible of more than 30 varieties. And let it be remarked further, that different kinds of verſe, by being adapted to different ſubjects and modes of writing, give variety to the poetic language, and multiply the charms of this pleaſing art.

71
The language of the epic poet muſt be elevated and his numbers uniformly majeſtic.

What has formerly been ſhown to be true in regard to ſtyle, will alſo in many caſes hold true of verſification, "that it is then *natural,* when it is adapted to the *ſuppoſed condition* of the ſpeaker."—In the epopee, the poet aſſumes the character of calm inſpiration; and therefore his language muſt be elevated, and his numbers majeſtic and uniform. A peaſant ſpeaking in heroic or hexameter verſe is no improbability here; becauſe his words are ſuppoſed to be tranſmitted by one who will of his own accord give them every ornament neceſſary to reduce them into dignified meaſure; as an eloquent man, in a ſolemn aſſembly, recapitulating the ſpeech of a clown, would naturally expreſs it in pure and perſpicuous language. The uniform heroic meaſure will ſuit any ſubject of dignity, whether narrative or didactic, that admits or requires uniformity of ſtyle. In tragedy, where the imitation of real life is more perfect than in epic poetry, the uniform magnificence of epic numbers might be improper; becauſe the heroes and heroines are ſuppoſed to ſpeak in their own perſons, and according to the immediate impulſe of paſſion and ſentiment. Yet, even in tragedy, the verſification may be both harmonious and dignified; becauſe the characters are taken chiefly from high life, and the events from a remote period; and becauſe the higher poetry is permitted to imitate nature, not as it is, but in that ſtate of perfection in which it might be. The Greeks and Romans conſidered their hexameter as too artificial for dramatic poetry; and therefore in tragedy, and even in comedy, made uſe of the iambic, and ſome other meaſures that came near the cadence of converſation: we uſe the iambic both in the epic and dramatic poem; but for the moſt part it is, or ought to be, much more elaborate in the former than in the latter. In dramatic comedy, where the manners and concerns of familiar life are exhibited, verſe would ſeem to be unnatural, except it be ſo like the ſound of common diſcourſe as to be hardly diſtinguiſhable from it. Cuſtom, however, may in ſome countries determine otherwiſe; and againſt cuſtom, in theſe matters, it is in vain to argue. The profeſſed enthuſiaſm of the dithyrambic poet renders wildneſs, variety, and a ſonorous harmony of numbers, peculiarly ſuitable to his odes. The love-ſonnet, and Anacreontic ſong, will be leſs various, more regu-

72
In tragedy the ſame uniform magnificence would be improper, and much more ſo in comedy.

lar, and of a ſofter harmony; becauſe the ſtate of mind expreſſed in it has more compoſure. Philoſophy can ſcarce go further in this inveſtigation, without deviating into whim and hypotheſis. The particular ſorts of verſe to be adopted in the lower ſpecies of poetry, are determined by faſhion chiefly, and the practice of approved authors.

III. The origin and principles of *imitative harmony*, or of that artifice by which the ſound is made, as Pope ſays, "an echo to the ſenſe," may be explained in the following manner.

73
A ſtriking analogy between moral and material beauty and deformity.

It is pleaſing to obſerve the uniformity of nature in all her operations. Between moral and material beauty and harmony, between moral and material deformity and diſſonance, there obtains a very ſtriking analogy. The viſible and audible expreſſions of almoſt every virtuous emotion are agreeable to the eye and the ear, and thoſe of almoſt every criminal paſſion diſagreeable. The looks, the attitudes, and the vocal ſounds, natural to benevolence, to gratitude, to compaſſion, to piety, are in themſelves graceful and pleaſing; while anger, diſcontent, deſpair, and cruelty, bring diſcord to the voice, deformity to the features and diſtortion to the limbs. That flowing curve, which painters know to be eſſential to the beauty of animal ſhape, gives place to a multiplicity of right lines and ſharp angles in the countenance and geſture of him who knits his brows, ſtretches his noſtrils, grinds his teeth, and clenches his fiſt; whereas, devotion magnanimity, benevolence, contentment, and good-humour, ſoften the attitude, and give a more graceful ſwell to the outline of every feature. Certain vocal tones accompany certain mental emotions. The voice of ſorrow is feeble and broken, that of deſpair boiſterous and incoherent; joy aſſumes a ſweet and ſprightly note, fear a weak and tremulous cadence; the tones of love and benevolence are muſical and uniform, thoſe of rage loud and diſſonant; the voice of the ſedate reaſoner is equable and grave, but not unpleaſant; and he who declaims with energy, employs many varieties of modulation ſuited to the various emotions that predominate in his diſcourſe.

But it is not in the language of paſſion only that the human voice varies its tone, or the human face its features. Every ſtriking ſentiment, and every intereſting idea, has an effect upon it. One would eſteem that perſon no adept in narrative eloquence, who ſhould deſcribe, with the very ſame accent, ſwift and ſlow motion, extreme labour and eaſy performance, agreeable ſenſation and excruciating pain; who ſhould talk of the tumult of a tempeſtuous ocean, the roar of thunder, the devaſtations of an earthquake, or an Egyptian pyramid tumbling into ruins, in the ſame tone of voice wherewith he deſcribes the murmur of a rill, the warbling of the harp of Æolus, the ſwinging of a cradle, or the deſcent of an angel. Elevation of mind gives dignity to the voice. From Achilles, Sarpedon, and Othello, we ſhould as naturally expect a manly and ſonorous accent, as a nervous ſtyle and majeſtic attitude. Coxcombs and bullies, while they aſſume airs of importance and valour, affect alſo a dignified articulation.

74
The ſource of imitative harmony of numbers.

Since the tones of natural language are ſo various, poetry, which imitates the language of nature, muſt alſo vary its tones; and, in reſpect of ſound as well as of meaning, be framed after that model of ideal perfection, which the variety and energy of the human articulate voice render probable. This is the more eaſily accompliſhed, becauſe in every language there is between the ſound and ſenſe of certain words a perceptible analogy; which, though not ſo accurate as to lead a foreigner from the ſound to the ſignification, is yet accurate enough to ſhow, that, in forming ſuch words, regard has been had to the imitative qualities of vocal ſound. Such, in Engliſh, are the words *yell*, *craſh*, *crack*, *hiſs*, *roar*, *murmur*, and many others.

All the particular laws that regulate this ſort of imitation, as far as they are founded in nature, and liable to the cognizance of philoſophy, depend on the general law of ſtyle above mentioned. Together with the other circumſtances of the ſuppoſed ſpeaker, the poet takes into conſideration the tone of voice ſuitable to the ideas that occupy his mind, and thereto adapts the ſound of his language, if it can be done conſiſtently with eaſe and elegance of expreſſion. But when this imitative harmony is too much ſought after, or words appear to be choſen for ſound rather than ſenſe, the verſe becomes finical and ridiculous. Such is Ronſard's affected imitation of the ſong of the ſky-lark:

Elle quindée du zephire
Sublime en l'air vire et revire,
Et y declique un joli cris,
Qui rit, guérit, et tire l'ire
Des eſprit mieux que je n'écris.

This is as ridiculous as that line of Ennius,

Tum tuba terribili ſonitu taratantara dixit:

Or as the following verſes of Swift:

The man with the kettle-drum enters the gate,
Dub dub a dub dub: the trumpeters follow,
Tantara tantara; while all the boys hollow.

75
What harmony of numbers can imitate.

Words by their ſound may imitate ſound; and quick or ſlow articulation may imitate quick or ſlow motion. Hence, by a proper choice and arrangement of words, the poet may imitate *Sounds* that are ſweet with dignity (H),—ſweet and tender (I),—loud (K),—and harſh

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(H) No ſooner had th' Almighty ceas'd than all
The multitude of angels, with a ſhout
Loud as from numbers without number, ſweet
As from bleſt voices uttering joy; heav'n rung
With jubilee, and loud hoſannas fill'd
Th' eternal regions.—— *Par. Loſt*, b. 3.

See alſo the night-ſtorm of thunder, lightning, wind, and rain, in Virg. Georg. lib. 1. ver. 328—334.

(I) Et longum, formoſe, vale, vale, inquit, Iola.
Virg. Ecl. 1.

Formoſam reſonare doces Amarillida ſilvas.
Virg. Ecl. 1.

See alſo the ſimile of the nightingale, Geor. lib, 4. verſ. 511. And ſee that wonderful couplet deſcribing the wailings of the owl, Æneid IV. 462.

(K) ————vibratus ab æthere fulgor
Cum ſonitu venit, et ruere omnia viſa repente,
Tyrrhenuſque tubæ mugire per æthera clangor,
Suſpiciunt: iterum atque iterum fragor intonat ingens.
Æneid. 8.

Of Poetical Harmony.

harſh (L);—and *Motions* that are ſlow in conſequence of dignity (M),—ſlow in conſequence of difficulty (N), ſwift and noiſy (O)—ſwift and ſmooth (P)—uneven and abrupt (Q),—quick and joyous (R). An unexpected pauſe in the verſe may alſo imitate a ſudden failure of ſtrength (S), or interruption of motion (T), or give vivacity to an image or thought, by fixing our attention longer than uſual upon the word that precedes it (U).—Moreover, when we deſcribe great bulk, it is natural for us to articulate ſlowly, even in common diſcourſe; and therefore a line of poetry that requires a ſlow pronunciation, or ſeems longer than it ſhould be, may be uſed with good effect in deſcribing vaſtneſs of ſize (X).—Sweet and ſmooth numbers are moſt proper, when the poet paints agreeable objects, or gentle energy (Y); and harſher ſounds when he ſpeaks of what is ugly, violent, or diſagreeable (Z). This too is according to the nature of common language; for we generally employ harſher tones of voice to expreſs what we diſlike, and more melodious notes to deſcribe the objects of love, complacency, or admiration. Harſh numbers, however, ſhould not be frequent in poetry: for

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See alſo the ſtorm in the firſt book of the Æneid, and in the fifth of the Odyſſey,

(L) The hoarſe rough verſe ſhall like the torrent roar.
Pope.

——On a ſudden open fly,
With impetuous recoil and jarring ſound,
Th' infernal doors, and on their hinges grate
Harſh thunder.—— *Par. Loſt*, II. 879.

See alſo Homer's Iliad, lib. 2. ver. 363. and Clarke's Annotation.

(M) See an exquiſite example in Gray's Progreſs of Poeſy: the concluſion of the third ſtanza.

(N) And when up ten ſteep ſlopes you've dragg'd
your thighs. *Pope.*

Juſt brought out this, when ſcarce his tongue could
ſtir. *Pope.*

——The huge leviathan
Wallowing unwieldy, enormous in their gait,
Tempeſt the ocean. *Par. Loſt*, VII. 411.

See the famous deſcription of Siſyphus rolling the ſtone, Odyſſ. lib. 11. ver. 592. See Quintil. Inſt. Orat. lib. 9. cap. 4. § 4, compared with Paradiſe Loſt, book 2. ver. 1022.

(O) Quadrupedante putrem ſonitu quatit ungula
campum *Æneid.*

Αυταρ επειτα πεδονδε κυλινδετο λαας αναιδης. *Odyſſ.* 11.

See alſe Virg. Æneid. lib. 1. ver. 83—87.

(P) See wild as the winds o'er the deſert he flies.
Pope.

Ille volat, ſimul arva fuga, ſimul æquora verrens.
Virg.

Ρηιδιη τ' επειτα πελει, χαλεπη πηρ εουσα. *Heſiod.*

(Q) Πολλα δ' αναντα καταντα παραντα τε δοχμια τ' ηλθον.
Hom.

The laſs ſhriek'd, ſtarted up, and ſhriek'd again.
Anonym.

(R) Let the merry bells ring round,
And the jocund rebecks ſound,
To many a youth, and many a maid,
Dancing in the chequer'd ſhade. *Milt. Allegro.*

See alſo Gray's Progreſs of Poeſy, ſtanza 3.

(S) Ac velut in ſomnis oculos ubi languida preſſit
Nocte quies, nequicquam avides extendere curſus
Velle videmur:—et in mediis conatibus ægri
Succidimus.—— *Æneid.*

See alſo Virg. Georg. lib. 3. ver. 515, 516.

(T) For this, be ſure to-night thou ſhalt have cramps,
Side-ſtitches that ſhall pen thy breath up. Urchins
Shall exerciſe upon thee.——
Proſpero to Calyban in *the Tempeſt.*

See Pope's Iliad, XIII. 199.

(U) ——How often from the ſteep.
Of echoing hill or thicket have we heard
Celeſtial voices, to the midnight air,
Sole,—or reſponſive to each other's note.
Singing their great Creator?—— *Par. Loſt*, b. 4.

And over them triumphant Death his dart
Shook,——but delay'd to ſtrike. *Id.*

See alſo Hom. Odyſſ. l. 9. v. 290.

(X) Thus ſtretch'd out, huge in length, the arch fiend
lay. *Par. Loſt.*

Monſtrum horrendum, informe, ingens, cui lumen
ademptum. *Æneid.* 3.

Et magnos membrorum artus, magna oſſa, lacertoſq;
Exuit, atque ingens media conſiſtit arena.
Æneid. v. 422.

(Y) Hic gelidi fontes, hic mollia prata, Lycori,
Hic nemus, hic ipſo tecum conſumerer ævo.
Virg. Ecl. 10

The dumb ſhall ſing; the lame his crutch forego,
And leap, exulting, like the bounding roe.
Pope's Meſſiah.

See Milton's deſcription of the evening, Par. Loſt, book 4. ver 598—609.

Ye gentle gales beneath my body blow,
And ſoftly lay me on the waves below.
Pope's Sappho.

(Z) Stridenti ſtipula miſerum diſperdere carmen.
Virg. Ecl. 3.

Immo ego Sardois videar tibi amarior herbis,
Horridior ruſco, projecta vilior alga.
Virg. Ecl. 7.

Neu patriæ validas in viſcera vertite vires.
Virg. Æneid. 6.

See alſo Milton's deſcription of the Lazar-houſe in Paradiſe Loſt, b. 11. v. 477—492.

for in this art, as in muſic, concord and melody ought always to predominate. And we find in fact, that good poets can occaſionally expreſs themſelves ſomewhat harſhly, when the ſubject requires it, and yet preſerve the ſweetneſs and majeſty of poetical diction. Further, the voice of complaint, pity, love, and all the gentler affections, is mild and muſical, and ſhould therefore be imitated in muſical numbers; while deſpair, defiance, revenge, and turbulent emotions in general, aſſume an abrupt and ſonorous cadence. Dignity of deſcription (A), ſolemn vows (B), and all ſentiments that proceed from a mind elevated with great ideas (C), require a correſpondent pomp of language and verſification.—Laſtly, an irregular or uncommon movement in the verſe may ſometimes be of uſe, to make the reader conceive an image in a particular manner. Virgil, deſcribing horſes running over rocky heights at full ſpeed, begins the line with two dactyls, to imitate rapidity, and concludes it with eight long ſyllables:

> Saxa per, et ſcopulos, et depreſſas convalles.
> *Geor.* III. 276.

which is a very unuſual meaſure, but ſeems well adapted to the thing expreſſed, namely, to the deſcent of the animal from the hills to the low ground. At any rate, this extraordinary change of the rhythm may be allowed to bear ſome reſemblance to the animal's change of motion, as it would be felt by a rider, and as we may ſuppoſe it is felt by the animal itſelf.

Other forms of imitative harmony, and many other examples, beſides thoſe referred to in the margin, will readily occur to all who are converſant in the writings of the beſt verſifiers, particularly Homer, Virgil, Milton, Lucretius, Spenſer, Dryden, Shakeſpeare, Pope and Gray.

PART II. OF THE DIFFERENT SPECIES OF POETRY, with their PARTICULAR PRINCIPLES.

SECT. I. *Of Epic and Dramatic Compoſitions.*

§ 1. *The Epopee and Drama compared.*

Elem. of Criticiſm.

76
In what tragic and epic poetry agree, and in what they differ.

TRAGEDY and the epic differ not in ſubſtantials: in both the ſame ends are propoſed, viz. inſtruction and amuſement; and in both the ſame mean is employed, viz. imitation of human actions. They differ only in the manner of imitating: epic poetry employs narration; tragedy repreſents its facts as paſſing in our ſight: in the former, the poet introduces himſelf as an hiſtorian: in the latter, he preſents his actors, and never himſelf.

This difference, regarding form only, may be thought ſlight: but the effects it occaſions are by no means ſo; for what we ſee makes a deeper impreſſion than what we learn from others. A narrative poem is a ſtory told by another: facts and incidents paſſing upon the ſtage, come under our own obſervation; and are beſide much enlivened by action and geſture, expreſſive of many ſentiments beyond the reach of language.

A dramatic compoſition has another property, independent altogether of action; which is, that it makes a deeper impreſſion than narration: in the former, perſons expreſs their own ſentiments; in the latter, ſentiments are related at ſecond-hand. For that reaſon, Ariſtotle, the father of critics, lays it down as a rule*, That in an epic poem the author ought to take every opportunity of introducing his actors, and of confining the narrative part within the narroweſt bounds. Homer underſtood perfectly the advantage of this method; and his poems are both of them in a great meaſure dramatic. Lucan runs to the oppoſite extreme: and is guilty of a ſtill greater fault in ſtuffing his *Pharſalia* with cold and languid reflections, the merit of which he aſſumes to himſelf, and deigns not to ſhare with his actors. Nothing can be more injudiciouſly timed, than a chain of ſuch reflections, which ſuſpend the battle of Pharſalia after the leaders had made their ſpeeches, and the two armies are ready to engage †.

* Poet. chap. 25. ſect. 6.

† Lib. 7. from line 385 to line 460.

77
Tragic and epic poetry pathetic or moral.

Ariſtotle, from the nature of the fable, divides tragedy into ſimple and complex: but it is of greater moment, with reſpect to dramatic as well as epic poetry, to found a diſtinction upon the different ends attained by ſuch compoſitions. A poem, whether dramatic or epic, that has nothing in view but to move the paſſions and to exhibit pictures of virtue and vice, may be diſtinguiſhed by the name of *pathetic*: but where a ſtory is purpoſely contrived to illuſtrate ſome moral truth, by ſhowing that diſorderly paſſions naturally lead to external misfortunes, ſuch compoſition may be denominated *moral*. Beſide making a deeper impreſſion than can be done by cool reaſoning, a moral poem does not fall ſhort of reaſoning in affording conviction: the natural connection of vice with miſery, and of virtue with happineſs may be illuſtrated by ſtating a fact as well as by urging an argument. Let us aſſume, for example, the following moral truths: That diſcord among the chiefs renders ineffectual all common meaſures; and that the conſequences of a ſlightly-founded quarrel, foſtered by pride and arrogance, are not leſs fatal than thoſe of the groſſeſt injury; theſe truths may be inculcated by the quarrel between Agamemnon and Achilles at the ſiege of Troy. If facts or circumſtances be wanting, ſuch as tend to rouſe the turbulent paſſions, they muſt be invented; but no accidental nor unaccountable event ought to be admitted; for the neceſſary or probable connection between vice and miſery is

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(A) See Virg. Geor. I. 328. and Homer, Virgil, and Milton, *paſſim.* See alſo Dryden's Alexander's Feaſt, and Gray's Odes.

(B) See Virg. Æneid, IV. 24.

(C) Examples are frequent in the great authors. See Othello's exclamation:

> ———O now for ever
> Farewel the tranquil mind! &c. *Act* 3. *ſc.* 3.

is not learned from any events but what are naturally occaſioned by the characters and paſſions of the perſons repreſented, acting in ſuch circumſtances. A real event, of which we ſee not the cauſe, may afford a leſſon, upon the preſumption that what hath happened may again happen: but this cannot be inferred from a ſtory that is known to be a fiction.

78 The good effects of ſuch compoſitions.

Many are the good effects of ſuch compoſitions. A pathetic compoſition, whether epic or dramatic, tends to a habit of virtue, by exciting us to do what is right, and reſtraining us from what is wrong. Its frequent pictures of human woes produce, beſide, two effects, extremely ſalutary: they improve our ſympathy, and fortify us to bear down our misfortunes. A moral compoſition muſt obviouſly produce the ſame good effects, becauſe by being moral it ceaſeth not to be pathetic: it enjoys beſides an excellence peculiar to itſelf; for it not only improves the heart as abovementioned, but inſtructs the head by the moral it contains. It ſeems impoſſible to imagine any entertainment more ſuited to a rational being, than a work thus happily illuſtrating ſome moral truth; where a number of perſons of different characters are engaged in an important action, ſome retarding, others promoting, the great cataſtrophe; and where there is dignity of ſtyle as well as of matter. A work of this kind has our ſympathy at command, and can put in motion the whole train of the ſocial affections: our curioſity in ſome ſcenes is excited, in others gratified; and our delight is conſummated at the cloſe, upon finding, from the characters and ſituations exhibited at the commencement, that every incident down to the final cataſtrophe is natural, and that the whole in conjunction make a regular chain of cauſes and effects.

79 The ſame ſubjects not always fit for tragic and epic poetry.

Conſidering that an epic and a dramatic poem are the ſame in ſubſtance, and have the ſame aim or end, one will readily imagine, that ſubjects proper for the one muſt be equally proper for the other. But conſidering their difference as to form, there will be found reaſon to correct that conjecture, at leaſt in ſome degree. Many ſubjects may indeed be treated with equal advantage in either form: but the ſubjects are ſtill more numerous for which they are not equally qualified; and there are ſubjects proper for the one and not at all for the other. To give ſome ſlight notion of the difference, as there is no room here for enlarging upon every article, we obſerve, that dialogue is better qualified for expreſſing ſentiments, and narrative for diſplaying facts. Heroiſm, magnanimity, undaunted courage, and other elevated virtues, figure beſt in action: tender paſſions, and the whole tribe of ſympathetic affections, figure beſt in ſentiment. It clearly follows, that tender paſſions are more peculiarly the province of tragedy, grand and heroic actions of epic poetry.

“ The epic poem is univerſally allowed to be *, of all poetical works, the moſt dignified, and, at the ſame time, the moſt difficult in execution. To contrive a ſtory which ſhall pleaſe and intereſt all readers, by being at once entertaining, important and inſtructive; to fill it with ſuitable incidents; to enliven it with a variety of characters and of deſcriptions; and, throughout a long work, to maintain that propriety of ſentiment, and that elevation of ſtyle, which the epic character requires, is unqueſtionably the higheſt effort of poetical genius.

* Blair's Lectures.

80 The proper ſubject of an epic poem.

“ The action or ſubject of the epic poem muſt be great and intereſting. Without greatneſs it would not have ſufficient importance either to fix our attention or to juſtify the magnificent apparatus which the poet beſtows on it. This is ſo evidently requiſite as not to require illuſtration; and, indeed, hardly any who have attempted epic poetry have failed in chooſing ſome ſubject ſufficiently important, either by the nature of the action or by the fame of the perſonages concerned in it. The fame of Homer's heroes, and the conſequences of diſſenſion between the greateſt of them, is a ſubject important in itſelf, and muſt have appeared particularly ſo to his countrymen, who boaſted their deſcent from thoſe heroes. The ſubject of the Æneid is ſtill greater than that of the Iliad, as it is the foundation of the moſt powerful empire that ever was eſtabliſhed upon this globe; an event of much greater importance than the deſtruction of a city, or the anger of a ſemibarbarous warrior. But the poems of Homer and Virgil fall in this reſpect infinitely ſhort of that of Milton. ‘ Before the greatneſs diſplayed in Paradiſe Loſt, it has been well obſerved § that all other greatneſs ſhrinks away. The ſubject of the Engliſh poet is not the deſtruction of a city, the conduct of a colony, or the foundation of an empire: it is the fate of worlds, the revolutions of heaven and earth; rebellion againſt the Supreme King, raiſed by the higheſt order of created beings; the overthrow of their hoſt, and the puniſhment of their crime; the creation of a new race of reaſonable creatures; their original happineſs and innocence, their forfeiture of immortality, and their reſtoration to hope and peace.”

§ Johnſon's Life of Milton.

An epic poem, however, is defective if its action be not intereſting as well as great; for a narrative of mere valour may be ſo conſtructed as to prove cold and tireſome. “ Much * will depend on the happy choice of ſome ſubject, which ſhall by its nature intereſt the public; as when the poet ſelects for his hero one who is the founder, or the deliverer, or the favourite of his nation; or when he writes atchievements that have been highly celebrated, or have been connected with important conſequences to any public cauſe. Moſt of the great epic poems are abundantly fortunate in this reſpect, and muſt have been very intereſting to thoſe ages in which they were compoſed.” The ſubject of the Paradiſe Loſt, as it is infinitely greater, muſt likewiſe be conſidered as more univerſally intereſting than that of any other poem. “ We all feel the effects of Adam's tranſgreſſion; we all ſin like him, and like him muſt all bewail our offences. We have reſtleſs and inſidious enemies in the fallen angels, and in the bleſſed ſpirits we have guardians and friends; in the redemption of mankind we hope to be included; in the deſcription of heaven and hell we are ſurely intereſted, as we are all to reſide hereafter either in the regions of horror or bliſs.”

* Blair ubi ſupra.

81 Circumſtances chiefly intereſting in epic poetry.

“ The chief circumſtance which renders an epic poem intereſting †, and which tends to intereſt not one age or country alone, but all readers, is the ſkilful conduct of the author in the management of his ſubject. His plan muſt comprehend many affecting incidents. He may ſometimes be awful and auguſt; he muſt often be tender and pathetic; he muſt give us gentle and pleaſing ſcenes of love, friendſhip, and affection. The more that an epic poem abounds with ſituations which

† Blair and Johnſon.

awaken the feelings of humanity, it is the more intereſting. In this reſpect perhaps no epic poets have been ſo happy as Virgil and Taſſo. The plan of the *Paradiſe Loſt* compriſes neither human actions nor human manners. The man and woman who act and ſuffer, are in a ſtate which no other man or woman can ever know. The reader finds no tranſaction in which he can be engaged; beholds no condition in which he can by any effort of imagination place himſelf; he has therefore little natural curioſity or ſympathy."

82
Whether the hero muſt neceſſarily be ſucceſsful.

A queſtion has been moved, Whether the nature of the epic poem does not require that the hero ſhould be ultimately ſucceſsful? To this queſtion Johnſon replies, that "there is no reaſon why the hero ſhould not be unfortunate, except eſtabliſhed practice, ſince ſucceſs and virtue do not neceſſarily go together." Moſt critics, however, are of a different opinion, and hold ſucceſs to be, if not the neceſſary, at leaſt the moſt proper iſſue of an epic poem. An unhappy concluſion depreſſes the mind, and is oppoſite to the elevating motions which belong to this ſpecies of poetry. Terror and compaſſion are the proper ſubjects of tragedy; but as the epic is of larger extent, it were too much, if, after the difficulties and troubles which commonly abound in the progreſs of the poem, the author ſhould bring them all at laſt to an unfortunate concluſion. We know not that any author of name has held this courſe except *Lucan*; for in the *Paradiſe Loſt*, as Adam's deceiver is at laſt cruſhed, and he himſelf reſtored to the favour of his maker, Milton's hero muſt be conſidered as finally ſucceſsful.

83
Different kinds of dramatic poetry.

We have no occaſion to ſay more of the epic, conſidered as peculiarly adapted to certain ſubjects, and to be conducted according to a certain plan. But as dramatic ſubjects are more complex, it is neceſſary to take a narrower view of them. They are either the light and the gay, or the grave and affecting, incidents of human life. The former conſtitute the ſubject of comedy, and the latter of tragedy.

As great and ſerious objects command more attention than little and ludicrous ones; as the fall of a hero intereſts the public more than the marriage of a private perſon; tragedy has been always held a more dignified entertainment than comedy. The firſt thing required of the tragic poet is, that he pitch upon ſome moving and intereſting ſtory, and that he conduct it in a natural and probable manner. For we muſt obſerve, that the natural and probable are more eſſential to tragic than even to epic poetry. Admiration is excited by the wonderful; but paſſion can be raiſed only by the impreſſions of nature and truth upon the mind.

84
Subjects beſt ſuited to tragedy.

The ſubject beſt fitted for tragedy is where a man has himſelf been the cauſe of his misfortune; not ſo as to be deeply guilty, nor altogether innocent: the misfortune muſt be occaſioned by a fault incident to human nature, and therefore in ſome degree venial. Such misfortunes call forth the ſocial affections, and warmly intereſt the ſpectator. An accidental misfortune, if not extremely ſingular, doth not greatly move our pity: the perſon who ſuffers, being innocent, is freed from the greateſt of all torments, that anguiſh of mind which is occaſioned by remorſe. An atrocious criminal, on the other hand, who brings misfortunes upon himſelf, excites little pity, for a different reaſon: his remorſe, it is true, aggravates his diſtreſs, and ſwells the firſt emotions of pity; but then our hatred of him as a criminal blending with pity, blunts its edge conſiderably. Misfortunes that are not innocent, nor highly criminal, partake the advantages of each extreme: they are attended with remorſe to embitter the diſtreſs, which raiſes our pity to a great height; and the ſlight indignation we have at a venial fault detracts not ſenſibly from our pity. The happieſt of all ſubjects accordingly for raiſing pity, is where a man of integrity falls into a great misfortune by doing an action that is innocent, but which, by ſome ſingular means, is conceived by him to be criminal: his remorſe aggravates his diſtreſs; and our compaſſion, unreſtrained by indignation, knows no bounds. Pity comes thus to be the ruling paſſion of a pathetic tragedy; and, by proper repreſentation, may be raiſed to a height ſcarce exceeded by any thing felt in real life. A moral tragedy takes in a larger field; as it not only exerciſes our pity, but raiſes another paſſion, which, though ſelfiſh, deſerves to be cheriſhed equally with the ſocial affection. The paſſion we have in view is fear or terror; for when a misfortune is the natural conſequence of ſome wrong bias in the temper, every ſpectator who is conſcious of ſuch a bias in himſelf takes the alarm, and dreads his falling into the ſame misfortune: and by the emotion of fear or terror, frequently reiterated in a variety of moral tragedies, the ſpectators are put upon their guard againſt the diſorders of paſſion.

The commentators upon Ariſtotle, and other critics, have been much gravelled about the account given of tragedy by that author: "That by means of pity and terror, it refines or purifies in us all ſorts of paſſion." But no one who has a clear conception of the end and effects of a good tragedy, can have any difficulty about Ariſtotle's meaning: Our pity is engaged for the perſons repreſented; and our terror is upon our own account. Pity indeed is here made to ſtand for all the ſympathetic emotions, becauſe of theſe it is the capital. There can be no doubt, that our ſympathetic emotions are refined or improved by daily exerciſe; and in what manner our other paſſions are refined by terror, has been juſt now ſaid. One thing is certain, that no other meaning can juſtly be given to the foregoing doctrine than that now mentioned; and that it was really Ariſtotle's meaning, appears from his 13th chapter, where he delivers ſeveral propoſitions conformable to the doctrine as here explained. Theſe, at the ſame time, we take liberty to mention; becauſe, ſo far as authority can go, they confirm the foregoing reaſoning about ſubjects proper for tragedy. The firſt propoſition is, That it being the province of tragedy to excite pity and terror, an innocent perſon falling into adverſity ought never to be the ſubject. This propoſition is a neceſſary conſequence of his doctrine as explained: a ſubject of that nature may indeed excite pity and terror; but the former in an inferior degree, and the latter in no degree for moral inſtruction. The ſecond propoſition is, That the hiſtory of a wicked perſon in a change from miſery to happineſs ought not to be repreſented; which excites neither terror nor compaſſion, nor is agreeable in any reſpect. The third is, That the misfortunes of a wicked perſon ought not to be repreſented: ſuch repreſentation may be agreeable in ſome meaſure upon a prinicple of juſtice; but it will not move our pity; nor any degree of terror, except in thoſe of the ſame vicious diſpoſition with the perſon repreſented. The laſt propoſition is, That the only character fit for repreſentation lies in the middle, neither eminently good nor eminently bad; where the misfortune is not the effect of deliberate vice, but of ſome involuntary fault, as our author expreſſes it. The only objection we find to Ariſtotle's account of tragedy, is, that he confines it within too narrow bounds, by refuſing admittance to the pathetic kind: for if terror be eſſential to tragedy, no repreſentation deſerves that name but the moral kind, where the misfortunes exhibited are cauſed by a wrong balance of mind, or ſome diſorder in the internal conſtitution: ſuch misfortunes always ſuggeſt moral inſtruction; and by ſuch misfortunes only can terror be excited for our improvement.

Thus Ariſtotle's four propoſitions abovementioned relate ſolely to tragedies of the moral kind. Thoſe of the pathetic kind are not confined within ſo narrow limits: ſubjects fitted for the theatre are not in ſuch plenty as to make us reject innocent misfortunes which rouſe our ſympathy, though they inculcate no moral. With reſpect indeed to the ſubjects of that kind, it may be doubted, whether the concluſion ought not always to be fortunate. Where a perſon of integrity is repreſented as ſuffering to the end under misfortunes purely accidental, we depart diſcontented, and with ſome obſcure ſenſe of injuſtice: for ſeldom is man ſo ſubmiſſive to Providence, as not to revolt againſt the tyranny and vexations of blind chance; he will be tempted to ſay, this ought not to be. We give for an example the *Romeo and Juliet* of Shakeſpeare, where the fatal cataſtrophe is occaſioned by Friar Laurence's coming to the monument a minute too late; we are vexed at the unlucky chance, and go away diſſatisfied. Such impreſſions, which ought not to be cheriſhed, are a ſufficient reaſon for excluding ſtories of this kind from the theatre.

85
The improper uſe of deſtiny in the ancient tragedies.

The misfortunes of a virtuous perſon, ariſing from neceſſary cauſes, or a chain of unavoidable circumſtances, as they excite a notion of deſtiny, are equally unſatisfactory to the human mind. A metaphyſician in his cloſet may reaſon himſelf into the belief of fate, or what in modern language is called *philoſophical neceſſity;* but the feelings of the heart revolt againſt that doctrine; and we have the confeſſion of the two ableſt philoſophers by whom it was ever maintained, that men conduct themſelves through life as if their will were abſolutely free, and their actions no part of a chain of neceſſary cauſes and effects. As no man goes to the theatre to ſtudy metaphyſics, or to diveſt himſelf of the common feelings of humanity, it is impoſſible, whatever be his philoſophical creed, that he ſhould contemplate without horror and diſguſt an innocent perſon ſuffering by mere deſtiny. A tragedy of uncommon merit in every other reſpect may indeed be endured, nay perhaps admired, though ſuch be its cataſtrophe; becauſe no work of man was ever perfect; and becauſe, where imperfections are unavoidable, a multitude of excellencies may be allowed to cover one fault: but we believe the miſery of an innocent perſon reſulting from a chain of unavoidable circumſtances has never been conſidered as a beauty by minds unperverted by a falſe philoſophy. "It muſt be acknowledged * that the ſubjects of the ancient Greek tragedies were frequently founded on mere deſtiny and inevitable misfortunes. In the courſe of the drama many moral ſentiments occurred; but the only inſtruction which the fable conveyed was, that reverence was due to the gods, and ſubmiſſion to the decrees of fate. Modern tragedy has aimed at a higher object, by becoming more the theatre of paſſion; pointing out to men the conſequences of their own miſconduct, ſhowing the direful effects which ambition, jealouſy, love, reſentment, and other ſuch ſtrong emotions, when miſguided or left unreſtrained, produce upon human life. An Othello, hurried by jealouſy to murder his innocent wife; a Jaſfier enſnared by reſentment and want to engage in a conſpiracy, and then ſtung with remorſe and involved in ruin; a Siffredi, through the deceit which he employs for public-ſpirited ends, bringing deſtruction on all whom he loved: theſe, and ſuch as theſe, are the examples which Tragedy now diſplays to public view; and by means of which it inculcates on men the proper government of their paſſions."

Blair.

86
How it is uſed in the tragedy of the Robbers.

There is indeed one ſingular drama, in which deſtiny is employed in a manner very different from that in which it was uſed by the poets of Greece and Rome. It is Schiller's Tragedy of the Robbers, of which "the hero, endowed by nature (as the tranſlator of the piece obſerves) with the moſt generous feelings, animated by the higheſt ſenſe of honour, and ſuſceptible of the warmeſt affections of the heart, is driven by the perfidy of a brother, and the ſuppoſed inhumanity of his father, into a ſtate of confirmed miſanthropy and deſpair." He wiſhes that he "could blow the trumpet of rebellion through all nature; that he could extinguiſh with one mortal blow the viperous race of men; and that he could ſo ſtrike as to deſtroy the germ of exiſtence." In this ſituation he is hurried on to the perpetration of a ſeries of crimes, which find from their very magnitude and atrocity a recommendation to his diſtempered mind. Senſible all the while of his own guilt, and ſuffering for that guilt the ſevereſt pangs of remorſe, he yet believes himſelf an inſtrument of vengeance in the hand of the Almighty for the puniſhment of the crimes of others. In thus accompliſhing the dreadful deſtiny which is preſcribed for him, he feels a ſpecies of gloomy ſatisfaction, at the ſame time that he conſiders himſelf as doomed to the performance of that part in life which is to conſign his memory to infamy and his ſoul to perdition. After burning a town, he exclaims, "O God of vengeance! am I to blame for this? Art thou to blame, O Father of Heaven! when the inſtruments of thy wrath, the peſtilence, flood, and famine overwhelm at once the righteous and the guilty? Who can command the flames to ſtay their courſe, to deſtroy only the noxious vermin, and ſpare the fertile field?" yet with the ſame breath, he accuſes himſelf of extreme criminality for "preſumptuouſly wielding the ſword of the Moſt High!" He frequently laments in the moſt affecting manner the loſs of his innocence, wiſhes that "he could return into the womb that bare him, that he hung an infant at the breaſt, that he were born a beggar, the meaneſt hind, a peaſant of the field." He conſiders himſelf as the outcaſt of Heaven, and finally rejected by the Father of mercy; yet he tells the band of robbers whom he commanded, that the "Almighty honoured them as agents in his hands to execute his wonderous purpoſes; employed them as his angels to execute his ſtern decrees, and pour the vi-of his wrath ;" and in a very ſolemn prayer, he ſuppoſes that "the God who ruleth over all had *decreed* that he ſhould become the chief of theſe foul murderers."

"It will be allowed, ſays the tranſlator, that the imagination could not have conceived a ſpectacle more deeply intereſting, more powerfully affecting to the mind of man, than that of a human being thus characteriſed and acting under ſuch impreſſions. The compaſſionate intereſt which the mind feels in the emotions or ſufferings of the guilty perſon, is not diminiſhed by the obſervation, that he acts under an impreſſion of inevitable deſtiny; on the contrary, there is ſomething in our nature which leads us the more to compaſſionate the inſtrument of thoſe crimes, that we ſee him conſider himſelf as bound to guilt by fetters, which he has the conſtant wiſh, but not the ſtrength, to break."

This is indeed true: we ſympathiſe with the hero of the Robbers, not only on account of his exalted ſentiments and his inflexible regard to the abſtract principles of honour and juſtice, but much more for that diſorder of intellect which makes him *ſuppoſe* "his deſtiny fixed and unalterable," at the very time that he is torn with remorſe for the perpetration of thoſe crimes by which he believed it to be fulfilling. Deſtiny, however, is not in this tragedy exhibited as real, but merely as the phantom of a diſtempered though noble mind. Had the poet repreſented his hero as in *fact decreed by God* or *bound by fate*, to head a band of foul murderers, and to commit a ſeries of the moſt atrocious crimes; though our pity for him might not have been leſſened, the impreſſions of the whole piece on the mind could have been only thoſe of horror and diſguſt at what would have appeared to us the unequal ways of providence.

87 Whether the ſubject of tragedy ſhould have its foundation in truth.

The Tragedy of the Robbers is a ſtriking inſtance of the juſtneſs of Dr Blair's criticiſm, in oppoſition to that of Lord Kames. His lordſhip holds that it is eſſential to a good tragedy, that its principal facts be borrowed from hiſtory; becauſe a mixture of known truth with the fable tends to delude us into a conviction of the reality of the whole. The Doctor conſiders this as a matter of no great conſequence; for "it is proved by experience, that a fictitious tale, if properly conducted, will melt the heart as much as any real hiſtory;" this obſervation is verified in the Robbers. It is indeed a very irregular drama, and perhaps could not be acted on a Britiſh theatre. But although the whole is known to be a fiction, we believe there are few effuſions of human genius which more powerfully excite the emotions of terror and pity. Truth is indeed congenial to the mind; and when a ſubject proper for tragedy occurs in hiſtory or tradition, it is perhaps better to adopt it than to invent one which has no ſuch foundation. But in chooſing a ſubject which makes a figure in hiſtory, greater precaution is neceſſary than where the whole is a fiction. In the latter caſe, the author is under no reſtraint other than that the characters and incidents be juſt copies of nature. But where the ſtory is founded on truth, no circumſtances muſt be added, but ſuch as connect naturally with what are known to be true; hiſtory may be ſupplied but muſt not be contradicted. Further, the ſubject choſen muſt be diſtant in time, or at leaſt in place; for the familiarity of recent perſons and events ought to be avoided. Familiarity ought more eſpecially to be avoided in an epic poem, the peculiar character of which is dignity and elevation: modern manners make but a poor figure in ſuch a poem. Their familiarity unqualifies them for a lofty ſubject. The dignity of them will be better underſtood in future ages, when they are no longer familiar.

After Voltaire, no writer, it is probable, will think, of rearing an epic poem upon a recent event in the hiſtory of his own country. But an event of that kind is perhaps not altogether unqualified for tragedy: it was admitted in Greece; and Skakeſpeare has employed it ſucceſsfully in ſeveral of his pieces. One advantage it poſſeſſes above fiction, that of more readily engaging our belief, which tends above any other particular to raiſe our ſympathy. The ſcene of comedy is generally laid at home: familiarity is no objection; and we are peculiarly ſenſible of the ridicule of our own manners.

88 How a tragedy ſhould be divided into acts; and how many acts it ſhould have. Elem. of Criticiſm, ch. 22.

After a proper ſubject is choſen, the dividing it into parts requires ſome art. The concluſion of a book in an epic poem, or of an act in a play, cannot be altogether arbitrary; nor be intended for ſo ſlight a purpoſe as to make the parts of equal length. The ſuppoſed pauſe at the end of every book, and the real pauſe at the end of every act, ought always to coincide with ſome pauſe in the action. In this reſpect, a dramatic or epic poem ought to reſemble a ſentence or period in language, divided into members that are diſtinguiſhed from each other by proper pauſes; or it ought to reſemble a piece of muſic, having a full cloſe at the end, preceded by imperfect cloſes that contribute to the melody. The diviſion of every play into *five* acts has no other foundation than common practice, and the authority of Horace (D). It is a diviſion purely arbitrary; there is nothing in the nature of the compoſition which fixes this number rather than any other; and it had been much better if no ſuch number had been aſcertained. But, ſince it is aſcertained, every act in a dramatic poem ought to cloſe with ſome incident that makes a pauſe in the action; for otherwiſe there can be no pretext for interrupting the repreſentation. It would be abſurd to break off in the very heat of action; againſt which every one would exclaim: the abſurdity ſtill remains where the action relents, if it be not actually ſuſpended for ſome time. This rule is alſo applicable to an epic poem: though in it a deviation from the rule is leſs remarkable; becauſe it is in the reader's power to hide the abſurdity, by proceeding inſtantly to another book. The firſt book of Paradiſe Loſt ends without any cloſe, perfect or imperfect: it breaks off abruptly, where Satan, ſeated on his throne, is prepared to harangue the convocated hoſt of the fallen angels; and the ſecond book begins with the ſpeech. Milton ſeems to have copied the Æneid, of which the two firſt books are divided much in the ſame

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(D) *Neve minor, neu ſit quinto productior actu*
Fabula. DE ARTE POETICA.

If you would have your play deſerve ſucceſs,
Give it five acts complete, nor more nor leſs. *Francis.*

ſame manner. Neither is there any proper pauſe at the end of the ſeventh book of Paradiſe Loſt, nor at the end of the eleventh. In the Iliad little attention is given to this rule.

89 The object of comedy.

Beſides tragedy, dramatic poetry comprehends comedy and farce. Theſe are ſufficiently diſtinguiſhed from tragedy by their general ſpirit and ſtrain. "While pity and terror, and the other ſtrong paſſions, form the province of the tragic muſe, the chief or rather ſole inſtrument of comedy and farce is ridicule." Theſe two ſpecies of compoſition are ſo perpetually running into each other, that we ſhall not treat of them ſeparately; ſince what is now known by the name of *farce* differs in nothing eſſential from what was called the *old comedy* among the Greeks. "Comedy propoſes for its object ‡ neither the great ſufferings nor the great crimes of men; but their follies and ſlighter vices, thoſe parts of their character which raiſe in beholders a ſenſe of impropriety, which expoſe them to be cenſured and laughed at by others, or which render them troubleſome in civil ſociety.

"The ſubjects of tragedy are not limited to any age or country; but the ſcene and ſubject of comedy ſhould always be laid in our own country, and in our own times. The reaſon is obvious: thoſe decorums of behaviour, thoſe leſſer diſcriminations of character, which afford ſubject for comedy, change with the differences of countries and times; and can never be ſo well underſtood by foreigners as by natives. The comic poet, who aims at correcting improprieties and follies of behaviour, ſhould 'catch the manners living as they riſe.' It is not his buſineſs to amuſe us with a tale of other times; but to give us pictures taken from among ourſelves; to ſatirize reigning and preſent vices; to exhibit to the age a faithful copy of itſelf, with its humours, its follies, and its extravagancies.

90 Comedy of two kinds.

"Comedy may be divided into two kinds: comedy of *character*, and comedy of *intrigue*. The former is the more valuable ſpecies; becauſe it is the buſineſs of comedy to exhibit the prevailing manners which mark the character of the age in which the ſcene is laid: yet there ſhould be always as much intrigue as to give us ſomething to wiſh and ſomething to fear. The incidents ſhould ſo ſucceed one another, as to produce ſtriking ſituations, and to fix our attention; while they afford at the ſame time a proper field for the exhibition of character. The action in comedy, though it demands the poet's care in order to render it animated and natural, is a leſs ſignificant and important part of the performance than the action in tragedy: as in comedy it is what men ſay, and how they behave, that draws our attention, rather than what they perform or what they ſuffer.

91 The common faults of comedy.

"In the management of characters, one of the moſt common faults of comic writers is the carrying of them too far beyond life. Wherever ridicule is concerned, it is indeed extremely difficult to hit the preciſe point where true wit ends and buffoonery begins. When the miſer in Plautus, ſearching the perſon whom he ſuſpects of having ſtolen his caſket, after examining firſt his right hand and then his left, cries out, *oſtende etiam tertiam*— 'ſhow me your third hand,' there is no one but muſt be ſenſible of the extravagance. Certain degrees of exaggeration are allowed to the comedian, but there are limits ſet to it by nature and good taſte; and ſuppoſing the miſer to be ever ſo much engroſſed by his jealouſy and his ſuſpicions, it is impoſſible to conceive any man in his wits ſuſpecting another of having more than two hands."

It appears from the plays of Ariſtophanes which remain, that the characters in the old comedy of Athens were almoſt always overcharged. They were likewiſe direct and avowed ſatires againſt particular perſons, who were brought upon the ſtage by name. "The ridicule employed in them is extravagant, the wit for the moſt part buffooniſh and farcical, the raillery biting and cruel, and the obſcenity that reigns in them is groſs and intolerable. They ſeem to have been compoſed merely for the mob." Yet of theſe abominable dramas, an excellent critic * has affirmed, with too much truth, that what is now called *farce* is nothing more than the ſhadow. The characters in genuine comedy are not thoſe of particular and known perſons, but the general characters of the age and nation; which it requires no ſmall ſkill to diſtinguiſh clearly and naturally from each other. In attempting this, poets are too apt to contraſt characters and introduce them always in pairs; which gives an affected air to the whole piece. The perfection of art is to conceal art. "A maſterly writer will give us his characters diſtinguiſhed rather by ſuch ſhades of diverſity as are commonly found in ſociety, than marked with ſuch ſtrong oppoſitions as are rarely brought into actual contraſt in any of the circumſtancss of real life."

92 The ſtyle of comedy.

The ſtyle of comedy ought to be pure, elegant, and lively, very ſeldom riſing higher than the ordinary tone of polite converſation; and upon no occaſion deſcending into vulgar, mean, and groſs expreſſions; and in one word, action and character being the fundamental parts of every epic and dramatic compoſition, the ſentiments and tone of language ought to be ſubſervient to theſe ſo as to appear natural and proper for the occaſion.

§ 2. *Reſpective peculiarities of the Epopee and Drama.*

93 Machinery can have no place in a drama, nor

In a theatrical entertainment, which employs both the eye and the ear, it would be a groſs abſurdity to introduce upon the ſtage ſuperior beings in a viſible ſhape. There is no place for ſuch objection in an *epic poem;* and Boileau, with many other critics, declares ſtrongly for that ſort of machinery in an epic poem. But waving authority, which is apt to impoſe upon the judgement, let us draw what light we can from reaſon. We may in the firſt place obſerve, that this matter is but indiſtinctly handled by critics: the poetical privilege of animating inſenſible objects for enlivening a deſcription, is very different from what is termed *machinery*, where deities, angels, devils, or other ſupernatural powers, are introduced as real perſonages, mixing in the action, and contributing to the cataſtrophe; and yet theſe two things are conſtantly jumbled together in reaſoning. The former is founded on a natural principle: but nothing is more unnatural than the latter. Its effects, at the ſame time, are deplorable. Firſt, it gives an air of fiction to the whole; and prevents that impreſſion of reality which is requiſite to intereſt our affections, and to move our paſſions; which of itſelf is ſufficient to explode machinery, whatever entertainment it may afford to readers of a fantaſtic taſte or irregular imagination. And, next, were it poſſible, by diſguiſing the fiction, to delude us into a notion of reality, an inſuperable objection would ſtill remain, which is, that the aim or end of an

94 Has it a good effect in the higher epic.

‡ Blair's Lectures.

* Hurd.

an epic poem can never be attained in any perfection where machinery is introduced; for an evident reaſon, that virtuous emotions cannot be raiſed ſucceſsfully but by the actions of thoſe who are endued with paſſions and affections like our own, that is, by human actions; and as for moral inſtruction, it is clear, that none can be drawn from beings who act not upon the ſame principles with us. A fable in Æſop's manner is no objection to this reaſoning: his lions, bulls, and goats, are truly men under diſguiſe; they act and feel in every reſpect as human beings; and the moral we draw is founded on that ſuppoſition. Homer, it is true, introduces the gods into his fable: but the religion of his country authoriſed that liberty; it being an article in the Grecian creed, that the gods often interpoſe viſibly and bodily in human affairs. It muſt however be obſerved, that Homer's deities do no honour to his poems; fictions that tranſgreſs the bounds of nature, ſeldom have a good effect; they may inflame the imagination for a moment, but will not be reliſhed by any perſon of a correct taſte. They may be of ſome uſe to the lower rank of writers; but an author of genius has much finer materials, of Nature's production, for elevating his ſubject, and making it intereſting.

One would be apt to think, that Boileau, declaring for the Heathen deities, intended them only for embelliſhing the diction: but unluckily he baniſhes angels and devils, who undoubtedly make a figure in poetic language, equal to the Heathen deities. Boileau, therefore, by pleading for the latter in oppoſition to the former, certainly meant, if he had any diſtinct meaning, that the Heathen deities may be introduced as actors. And, in fact, he himſelf is guilty of that glaring abſurdity, where it is not ſo pardonable as in an epic poem: In his ode upon the taking of Namur, he demands with a moſt ſerious countenance, whether the walls were built by Apollo or Neptune: and in relating the paſſage of the Rhine, *anno* 1672, he deſcribes the god of that river as fighting with all his might to oppoſe the French monarch; which is confounding fiction with reality at a ſtrange rate. The French writers in general run into this error: wonderful the effect of cuſtom, entirely to hide from them how ridiculous ſuch fictions are.

That this is a capital error in *Gieruſalemme Liberata*, Taſſo's greateſt admirers muſt acknowledge: a ſituation can never be intricate, nor the reader ever in pain about the cataſtrophe, ſo long as there is an angel, devil, or magician, to lend a helping hand. Voltaire, in his eſſay upon epic poetry, talking of the *Pharſalia*, obſerves judiciouſly, "That the proximity of time, the notoriety of events, the character of the age, enlightened and political, joined with the ſolidity of Lucan's ſubject, deprived him of poetical fiction." Is it not amazing, that a critic who reaſons ſo juſtly with reſpect to others, can be ſo blind with reſpect to himſelf? Voltaire, not ſatisfied to enrich his language with images drawn from inviſible and ſuperior beings, introduces them into the action: in the ſixth canto of the *Henriade*, St Louis appears in perſon, and terrifies the ſoldiers; in the ſeventh canto, St Louis ſends the god of Sleep to Henry; and, in the tenth, the demons of Diſcord, Fanaticiſm, War, &c. aſſiſt Aumale in a ſingle combat with Turenne, and are driven away by a good angel brandiſhing the ſword of God. To blend ſuch fictitious parſonages in the ſame action with mortals, makes a bad figure at any rate; and is intolerable in a hiſtory ſo recent as that of Henry IV. But perfection is not the lot of man.

But perhaps the moſt ſucceſsful weapon that can be employed upon this ſubject is ridicule. Addiſon has applied this in an elegant manner: "Whereas the time of a general peace is, in all appearance, drawing near; being informed that there are ſeveral ingenious perſons who intend to ſhow their talents on ſo happy an occaſion, and being willing, as much as in me lies, to prevent that effuſion of nonſenſe which we have good cauſe to apprehend; I do hereby ſtrictly require every perſon who ſhall write on this ſubject, to remember that he is a Chriſtian, and not to ſacrifice his catechiſm to his poetry. In order to it, I do expect of him, in the firſt place, to make his own poem, without depending upon Phœbus for any part of it, or calling out for aid upon any of the Muſes by name. I do likewiſe poſitively forbid the ſending of Mercury with any particular meſſage or diſpatch relating to the peace; and ſhall by no means ſuffer Minerva to take upon her the ſhape of any plenipotentiary concerned in this great work. I do further declare, that I ſhall not allow the Deſtinies to have had a hand in the deaths of the ſeveral thouſands who have been ſlain in the late war; being of opinion that all ſuch deaths may be well accounted for by the Chriſtian ſyſtem of powder and ball. I do therefore ſtrictly forbid the Fates to cut the thread of man's life upon any pretence whatſoever, unleſs it be for the ſake of rhyme. And whereas I have good reaſon to fear, that Neptune will have a great deal of buſineſs on his hands in ſeveral poems which we may now ſuppoſe are upon the anvil, I do alſo prohibit his appearance, unleſs it be done in metaphor, ſimile, or any very ſhort alluſion; and that even here he may not be permitted to enter, but with great caution and circumſpection. I deſire that the ſame rule may be extended to his whole fraternity of Heathen gods; it being my deſign to condemn every poem to the flames in which Jupiter thunders, or exerciſes any other act of authority which does not belong to him. In ſhort, I expect that no Pagan agent ſhall be introduced, or any fact related which a man cannot give credit to with a good conſcience. Provided always, that nothing herein contained ſhall extend, or be conſtrued to extend, to ſeveral of the female poets in this nation, who ſhall ſtill be left in full poſſeſſion of their gods and goddeſſes, in the ſame manner as if this paper had never been written." *Spect.* n° 523.

The marvellous is indeed ſo much promoted by machinery, that it is not wonderful to find it embraced by the bulk of writers, and perhaps of readers. If indulged at all, it is generally indulged to exceſs. Homer introduceth his deities with no greater ceremony than his mortals; and Virgil has ſtill leſs moderation: a pilot ſpent with watching cannot fall aſleep and drop into the ſea by natural means one bed cannot receive the two lovers Æneas and Dido, without the immediate interpoſition of ſuperior powers. The ridiculous in ſuch fictions muſt appear even through the thickeſt veil of gravity and ſolemnity.

Angels and devils ſerve equally with Heathen deities as materials for figurative language; perhaps better among Chriſtians, becauſe we believe in them, and not in Heathen deities. But every one is ſenſible, as well as Boileau, that the inviſible powers in our creed make a much worſe figure as actors in a modern poem than the inviſible powers in the heathen creed did in ancient poems; the cauſe of which is not far to ſeek. The Heathen deities, in the opinion of their votaries, were beings elevated one ſtep only above mankind, ſubject to the ſame paſſions, and directed by the ſame motives; therefore not altogether improper to mix with men in an important action. In our creed, ſuperior beings are placed at ſuch a mighty diſtance from us and are of a nature ſo different, that with no propriety can we appear with them upon the ſame ſtage: man, a creature much inferior, loſes all dignity in the compariſon.

95 An hiſtorical poem admits of allegory, &c. under proper reſtrictions.

There can be no doubt that an hiſtorical poem admits the embelliſhment of allegory as well as of metaphor, ſimile, or other figure. Moral truth, in particular, is finely illuſtrated in the allegorical manner: it amuſes the fancy to find abſtract terms, by a ſort of magic, metamorphoſed into active beings; and it is delightful to trace a general propoſition in a pictured event. But allegorical beings ſhould be confined within their own ſphere, and never be admitted to mix in the principal action, nor to co-operate in retarding or advancing the cataſtrophe; which would have a ſtill worſe effect than inviſible powers: for the impreſſion of real exiſtence, eſſential to an epic poem, is inconſiſtent with that figurative exiſtence which is eſſential to an allegory; and therefore no method can more effectually prevent the impreſſion of reality than the introduction of allegorical beings co-operating with thoſe whom we conceive to be really exiſting. The love epiſode in the Henriade (canto 9.), inſufferable by the diſcordant mixture of allegory with real life, is copied from that of Rinaldo and Armida in the *Gieruſalemme Liberata*, which hath no merit to intitle it to be copied. An allegorical object, ſuch as Fame in the Æneid, and the Temple of Love in the Henriade, may find place in a deſcription: but to introduce Diſcord as a real perſonage, imploring the aſſiſtance of Love as another real perſonage to enervate the courage of the hero, is making theſe figurative beings act beyond their ſphere, and creating a ſtrange jumble of truth and fiction. The allegory of Sin and Death in the Paradiſe Loſt is poſſibly not generally reliſhed, though it is not entirely of the ſame nature with what we have been condemning; in a work comprehending the atchievements of ſuperior beings there is more room for fancy than where it is confined to human actions.

96 Epiſode defined.

What is the true notion of an epiſode? or how is it to be diſtinguiſhed from the principal action? Every incident that promotes or retards the cataſtrophe muſt be part of the principal action. This clears the nature of an epiſode; which may be defined, "An incident connected with the principal action, but contributing neither to advance nor retard it." The deſcent of Æneas into hell does not advance nor retard the cataſtrophe, and therefore is an epiſode. The ſtory of Niſus and Euryalus, producing an alteration in the affairs of the contending parties, is a part of the principal action. The family-ſcene in the ſixth book of the Iliad is of the ſame nature; for by Hector's retiring from the field of battle to viſit his wife, the Grecians had opportunity to breathe, and even to turn upon the Trojans. The unavoidable effect of an epiſode according to this definition muſt be, to break the unity of action; and herefore it ought never to be indulged unleſs to unbend the mind after the fatigue of a long narration. An epiſode when ſuch is its purpoſe, requires the following conditions: it ought to be well connected with the principal action; it ought to be lively and intereſting; it ought to be ſhort; and a time ought to be choſen when the principal action relents (E).

97 What conſtitutes a good epiſode.

In the following beautiful epiſode, which cloſes the ſecond book of Fingal, all theſe conditions are united.

"Comal was a ſon of Albion; the chief of an hundred hills. His deer drunk of a thouſand ſtreams; and a thouſand rocks replied to the voice of his dogs. His face was the mildneſs of youth; but his hand the death of heroes. One was his love, and fair was ſhe! the daughter of mighty Conloch. She appeared like a ſunbeam among women, and her hair was like the wing of the raven. Her ſoul was fixed on Comal, and ſhe was his companion in the chace. Often met their eyes of love, and happy were their words in ſecret. But Gormal loved the maid, the chief of gloomy Ardven. He watched her lone ſteps on the heath, the foe of unhappy Comal.

"One day, tired of the chace, when the miſt had concealed their friends, Comal and the daughter of Conloch met in the cave of Ronan. It was the wonted haunt of Comal. Its ſides were hung with his arms; a hundred ſhields of thongs were there, a hundred helmets of ſounding ſteel. Reſt here, ſaid he, my love Galvina, thou light of the cave of Ronan: a deer appears on Mora's brow; I go, but ſoon will return. I fear, ſaid ſhe, dark Gormal my foe: I will reſt here; but ſoon return, my love.

"He went to the deer of Mora. The daughter of Conloch, to try his love, clothed her white ſide with his armour, and ſtrode from the cave of Ronan. Thinking her his foe, his heart beat high, and his colour changed. He drew the bow: the arrow flew: Galvina fell in blood. He ran to the cave with haſty ſteps, and called the daughter of Conloch. Where art thou, my love? but no anſwer.——He marked, at length, her heaving heart beating againſt the mortal arrow. O Conloch's daughter, is it thou!—he ſunk upon her breaſt.

"The hunters found the hapleſs pair. Many and ſilent were his ſteps round the dark dwellings of his love. The fleet of the ocean came: he fought, and the ſtrangers fell: he ſearched for death over the field; but who could kill the mighty Comal? Throwing away his ſhield an arrow found his manly breaſt. He ſleeps with his Galvina: their green tombs are ſeen by the mariner when he bounds on the waves of the north."

Next, upon the peculiarities of a *dramatic poem*. And the

(E) Homer's deſcription of the ſhield of Achilles is properly introduced at a time when the action relents, and the reader can bear an interruption. But the author of Telemachus deſcribes the ſhield of that young hero in the heat of battle; a very improper time for an interruption.

98 Double plot in a drama ſeldom ſucceſsful.

the firſt we ſhall mention is a double plot: one of which muſt reſemble an epiſode in an epic poem; for it would diſtract the ſpectator, inſtead of entertaining him, if he were forced to attend at the ſame time to two capital plots equally intereſting. And even ſuppoſing it an under-plot like an epiſode, it ſeldom hath a good effect in tragedy, of which ſimplicity is a chief property; for an intereſting ſubject that engages our affections, occupies our whole attention, and leaves no room for any ſeparate concern. Variety is more tolerable in comedy; which pretends only to amuſe, without totally occupying the mind. But even there, to make a double plot agreeable, is no ſlight effort of art: the under plot ought not to vary greatly in its tone from the principal; for diſcordant emotions are unpleaſant when jumbled together; which, by the way, is an inſuperable objection to tragi-comedy. Upon that account the Provok'd Huſband deſerves cenſure; all the ſcenes that bring the family of the Wrongheads into action, being ludicrous and farcical, are in a very different tone from the principal ſcenes, diſplaying ſevere and bitter expoſtulations between Lord Townley and his lady. The ſame objection touches not the double plot of the Careleſs Huſband; the different ſubjects being ſweetly connected, and having only ſo much variety as to reſemble ſhades of colours harmoniouſly mixed. But this is not all. The under-plot ought to be connected with that which is principal, ſo much at leaſt as to employ the ſame perſons: the under-plot ought to occupy the intervals or pauſes of the principal action; and both ought to be concluded together. This is the caſe of the Merry Wives of Windſor.

99 Violent action ought not to be repreſented.

Violent action ought never to be repreſented on the ſtage. While the dialogue goes on, a thouſand particulars concur to delude us into an impreſſion of reality; genuine ſentiments, paſſionate language, and perſuaſive geſture: the ſpectator, once engaged, is willing to be deceived, loſes ſight of himſelf, and without ſcruple enjoys the ſpectacle as a reality. From this abſent ſtate he is rouſed by violent action; he wakes as from a pleaſing dream; and, gathering his ſenſes about him, finds all to be a fiction. Horace delivers the ſame rule; and ſounds it upon the ſame reaſon:

> Ne peuros coram populo Medea trucidet;
> Aut humana palam coquat exta nefarius Atreus;
> Aut in avem Progne vertatur, Cadmus in anguem:
> Quodcumque oſtendis mihi ſic, incredulus odi.

The French critics join with Horace in excluding blood from the ſtage; but overlooking the moſt ſubſtantial objection, they urge only that it is barbarous and ſhocking to a polite audience. The Greeks had no notion of ſuch delicacy or rather effeminacy; witneſs the murder of Clytemneſtra by her ſon Oreſtes, paſſing behind the ſcene, as repreſented by Sophocles: her voice is heard calling out for mercy, bitter expoſtulations on his part, loud ſhrieks upon her being ſtabbed, and then a deep ſilence. An appeal may be made to every perſon of feeling, whether this ſcene be not more horrible than if the deed had been committed in ſight of the ſpectators upon a ſudden guſt of paſſion. If Corneille, in repreſenting the affair betwen Horatius and his ſiſter, upon which the murder enſues behind the ſcene, had no other view but to remove from the ſpectators a ſhocking action, he was guilty of a capital miſtake: for murder in cold blood, which in ſome meaſure was the caſe as repreſented, is more ſhocking to a polite audience, even where the concluſive ſtab is not ſeen, than the ſame act performed in their preſence by violent and unpremeditated paſſion, as ſuddenly repented of as committed. Addiſon's obſervation is juſt †, That no part of this incident ought to have been repreſented but reſerved for a narrative, with every alleviating circumſtance in favour of the hero.

100 The proper conduct of the dialogue.

A few words upon the dialogue, which ought to be ſo conducted as to be a true repreſentation of nature. We talk not here of the ſentiments nor of the language (which are treated elſewhere): but of what properly belongs to dialogue-writing; where every ſingle ſpeech, ſhort or long, ought to ariſe from what is ſaid by the former ſpeaker, and furniſh matter for what comes after till the end of the ſcene. In this view all the ſpeeches from firſt to laſt repreſent ſo many links of one regular chain. No author, ancient or modern, poſſeſſes the art of dialogue equal to Shakeſpeare. Dryden, in that particular, may juſtly be placed as his oppoſite. He frequently introduces three or four perſons ſpeaking upon the ſame ſubject, each throwing out his own notions ſeparately, without regarding what is ſaid by the reſt: take for an example the firſt ſcene of Aurenzebe. Sometimes he makes a number club in relating an event, not to a ſtranger, ſuppoſed ignorant of it, but to one another, for the ſake merely of ſpeaking: of which notable ſort of dialogue we have a ſpecimen in the firſt ſcene of the firſt part of the Conqueſt of Granada. In the ſecond part of the ſame tragedy, ſcene ſecond, the King, Abenamar, and Zulema, make their ſeparate obſervations, like ſo many ſoliloquies, upon the fluctuating temper of the mob: a dialogue ſo uncouth puts one in mind of two ſhepherds in a paſtoral excited by a prize to pronounce verſes alternately, each in praiſe of his own miſtreſs.

This manner of dialogue-writing, beſide an unnatural air, has another bad effect: it ſtays the courſe of the action, becauſe it is not productive of any conſequence. In Congreve's comedies, the action is often ſuſpended to make way for a play of wit.

No fault is more common among writers than to prolong a ſpeech after the impatience of the perſon to whom it is addreſſed ought to prompt him or her to break in. Conſider only how the impatient actor is to behave in the mean time. To expreſs his impatience in violent action without interrupting would be unnatural; and yet to diſſemble his impatience, by appearing cool where he ought to be highly inflamed, would be no leſs ſo.

Rhyme being unnatural and diſguſtful in dialogue, is happily baniſhed from our theatre: the only wonder is that it ever found admittance, eſpecially among a people accuſtomed to the more manly freedom of Shakeſpeare's dialogue. By baniſhing rhyme, we have gained ſo much as never once to dream that there can be any further improvement. And yet, however ſuitable blank verſe may be to elevated characters and warm paſſions, it muſt appear improper and affected in the mouths of the lower ſort. Why then ſhould it be a rule, That every ſcene in tragedy muſt be in blank verſe? Shakeſpeare, with great judgment, has followed a different rule; which is, to intermix proſe with verſe, and only to employ the latter where it is required by the importance or dignity of the ſubject. Familiar thoughts and ordinary facts ought to be expreſſed in plain language; to hear, for example a footman deliver a ſimple meſſage in blank verſe muſt appear ridiculous to every one who is not biaſſed by cuſtom. In ſhort that variety of characters and of ſituations, which is the life of a play, requires not only a ſuitable variety in the ſentiments, but alſo in the diction.

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† Spectator, Nº 44.

§ 3. *The Three Unities.*

When we conſider the chain of cauſes and effects in the material world, independent of purpoſe, deſign, or thought, we find a number of incidents in ſucceſſion, without beginning, middle, or end: every thing that happens, is both a cauſe and an effect; being the effect of what goes before, and the cauſe of what follows: one incident may affect us more, another leſs; but all of them are links in the univerſal chain: the mind, in viewing theſe incidents, cannot reſt or ſettle ultimately upon any one; but is carried along in the train without any cloſe.

101 In what the unity of action conſiſts.

But when the intellectual world is taken under view, in conjunction with the material, the ſcene is varied. Man acts with deliberation, will, and choice: he aims at ſome end; glory, for example, or riches, or conqueſt, the procuring happineſs to individuals, or to his country in general: he propoſes means, and lays plans to attain the end propoſed. Here are a number of facts or incidents leading to the end in view, the whole compoſing one chain by the relation of cauſe and effect. In running over a ſeries of ſuch facts or incidents, we cannot reſt upon any one; becauſe they are preſented to us as means only, leading to ſome end: but we reſt with ſatiſfaction upon the end or ultimate event; becauſe there the purpoſe or aim of the chief perſon or perſons is accompliſhed. This indicates the beginning, the middle, and the end, of what Ariſtotle calls *an entire action**. The ſtory naturally begins with deſcribing thoſe circumſtances which move the perſon who acts the principal part to form a plan, in order to compaſs ſome deſired event; the proſecution of that plan, and the obſtructions, carry the reader into the heat of action; the middle is properly where the action is the moſt involved; and the end is where the event is brought about, and the plan accompliſhed.

* Poet. c. 6.

We have given the foregoing example of a plan crowned with ſucceſs, becauſe it affords the cleareſt conception of a beginning, a middle, and an end, in which conſiſts *unity* of action; and indeed ſtricter unity cannot be imagined than in that caſe. But an action may have unity, or a beginning, middle, and end, without ſo intimate a relation of parts; as where the cataſtrophe is different from what is intended or deſired, which frequently happens in our beſt tragedies. In the Æneid, the hero, after many obſtructions makes his plan effectual. The Iliad is formed upon a different model: it begins with the quarrel between Achilles and Agamemnon; goes on to deſcribe the ſeveral effects produced by that cauſe; and ends in a reconciliation. Here is unity of action, no doubt, a beginning, a middle, and an end; but inferior to that of the Æneid, which will thus appear. The mind hath a propenſity to go forward in the chain of hiſtory; it keeps always in view the expected event; and when the incidents or underparts are connected by their relation to the event, the mind runs ſweetly and eaſily along them. This pleaſure we have in the Æneid. It is not altogether ſo pleaſant to connect, as in the Iliad, effects by their common cauſe; for ſuch connection forces the mind to a continual retroſpect: looking backward is like walking backward.

Elem. of Criticiſm.

102 Unity of action a capital beauty.

If unity of action be a capital beauty in fable imitative of human affairs, a plurality of unconnected fables muſt be a capital deformity. For the ſake of variety, we indulge an under-plot that is connected with the principal: but two unconnected events are extremely unpleaſant, even where the ſame actors are engaged in both. Arioſto is quite licentious in that particular: he carries on at the ſame time a plurality of unconnected ſtories. His only excuſe is, that his plan is perfectly well adjuſted to his ſubject; for every thing in the *Orlando Furioſo* is wild and extravagant.

Though to ſtate facts in the order of time is natural, yet that order may be varied for the ſake of conſpicuous beauties. If, for example, a noted ſtory, cold and ſimple in its firſt movements, be made the ſubject of an epic poem, the reader may be hurried into the heat of action; reſerving the preliminaries for a converſation-piece, if thought neceſſary: and that method, at the ſame time, hath a peculiar beauty from being dramatic. But a privilege that deviates from nature ought to be ſparingly indulged; and yet romance-writers make no difficulty of preſenting to the reader, without the leaſt preparation, unknown perſons engaged in ſome arduous adventure equally unknown. In Caſſandra, two perſonages, who afterwards are diſcovered to be the heroes of the fable, ſtart up completely armed upon the banks of the Euphrates, and engage in a ſingle combat.

A play analyſed is a chain of connected facts, of which each ſcene makes a link. Each ſcene, accordingly, ought to produce ſome incident relative to the cataſtrophe or ultimate event, by advancing or retarding it. A ſcene that produceth no incident, and for that reaſon may be termed *barren*, ought not to be indulged, becauſe it breaks the unity of action: a barren ſcene can never be intitled to a place, becauſe the chain is complete without it. In the Old Bachelor, the 3d ſcene of act 2. and all that follow to the end of that act, are mere converſation-pieces, productive of no conſequence. The 10th and 11th ſcenes, act 3. Double Dealer, and the 10th, 11th, 12th, 13th, and 14th ſcenes, act 1. Love for Love, are of the ſame kind. Neither is The Way of the World entirely guiltleſs of ſuch ſcenes. It will be no juſtification that they help to diſplay characters: it were better, like Dryden in his *dramatis perſonæ*, to deſcribe characters beforehand, which would not break the chain of action. But a writer of genius has no occaſion for ſuch artifice: he can diſplay the characters of his perſonages much more to the life in ſentiment and action. How ſucceſsfully is this done by Shakeſpeare! in whoſe works there is not to [illegible] found a ſingle barren ſcene.

Upon the whole it appears, that all the facts in an hiſtorical fable ought to have a mutual connection, by their common relation to the grand event or cataſtrophe. And this relation, in which the *unity* of action conſiſts, is equally eſſential to epic and dramatic compoſitions.

103 Whether unity of time and of place be eſſential

How far the unities of time and of place are eſſential, is a queſtion of greater intricacy. Theſe unities were ſtrictly obſerved in the Greek and Roman theatres; and they are inculcated by the French and Engliſh critics as eſſential to every dramatic compoſition. In theory theſe unities are alſo acknowledged by our beſt poets, though their practice ſeldom correſponds: they are often forced to take liberties, which they pretend not to juſtify, againſt the practice of the Greeks and Romans, and againſt the ſolemn deciſion of their own countrymen. But in the courſe of this inquiry it will be made evident, that in this article we are under no neceſſity to copy the ancients; and that our critics are guilty of a miſtake, in admitting no greater latitude of place and time than was admitted in Greece and Rome.

Indeed the unities of place and time are not, by the moſt rigid critics, required in a narrative poem. In ſuch compoſition, if it pretend to copy nature, theſe unities would be abſurd; becauſe real events are ſeldom confined within narrow limits either of place or of time: and yet we can follow hiſtory, or an hiſtorical fable, through all its changes, with the greateſt facility: we never once think of meaſuring the real time by what is taken in reading; nor of forming any connection between the place of action and that which we occupy.

We are aware, that the drama differs ſo far from the epic as to admit different rules. It will be obſerved, "That an hiſtorical fable, intended for reading ſolely, is under no limitation of time or of place more than a genuine hiſtory; but that a dramatic compoſition cannot be accurately repreſented unleſs it be limited, as its repreſentation is, to one place and to a few hours; and therefore that no fable can be admitted but what has theſe properties, becauſe it would be abſurd to compoſe a piece for repreſentation that cannot be juſtly repreſented." This argument has at leaſt a plauſible appearance; and yet one is apt to ſuſpect ſome fallacy, conſidering that no critic, however ſtrict, has ventured to confine the unities of place and of time within ſo narrow bounds.

A view of the Grecian drama, compared with our own, may perhaps relieve us from this dilemma: if they be differently conſtructed, as ſhall be made evident, it is poſſible that the foregoing reaſoning may not be equally applicable to both.

104
They were eſſential to the Greek drama, but

All authors agree, that tragedy in Greece was derived from the hymns in praiſe of Bacchus, which were ſung in parts by a chorus. Theſpis, to relieve the ſingers, and for the ſake of variety, introduced one actor, whoſe province it was to explain hiſtorically the ſubject of the ſong, and who occaſionally repreſented one or other perſonage. Eſchylus, introducing a ſecond actor, formed the dialogue; by which the performance became dramatic; and the actors were multiplied when the ſubject repreſented made it neceſſary. But ſtill the chorus, which gave a beginning to tragedy, was conſidered as an eſſential part. The firſt ſcene, generally, unfolds the preliminary circumſtances that lead to the grand event; and this ſcene, is by Ariſtotle termed the *prologue*. In the ſecond ſcene, where the action properly begins, the chorus is introduced, which, as originally, continues upon the ſtage during the whole performance: the chorus frequently makes one in the dialogue; and when the dialogue happens to be ſuſpended, the chorus, during the interval, is employed in ſinging. Sophocles adhers to this plan religiouſly. Euripides is not altogether ſo correct. In ſome of his pieces it becomes neceſſary to remove the chorus for a little time: but when that unuſual ſtep is riſked, matters are ſo ordered as not to interrupt the repreſentation: the chorus never leave the ſtage of their own accord, but at the command of ſome principal perſonage, who conſtantly waits their return.

Thus the Grecian drama is a continued repreſentation without any interruption; a circumſtance that merits attention. A continued repreſentation without a pauſe affords not opportunity to vary the place of action, nor to prolong the time of the action beyond that of the repreſentation. To a repreſentation ſo confined in place and time, the foregoing reaſoning is ſtrictly applicable: a real or feigned action, that is brought to a concluſion after conſiderable intervals of time and frequent changes of place, cannot accurately be copied in a repreſentation that admits no latitude in either. Hence it is, that the unities of place and of time, were, or ought to have been ſtrictly obſerved in the Greek tragedies; which is made neceſſary by the very conſtitution of their drama, for it is abſurd to compoſe a tragedy that cannot be juſtly repreſented.

105
Not to the French or Engliſh.

Modern critics, who for our drama pretend to eſtabliſh rules founded on the practice of the Greeks, are guilty of an egregious blunder. The unities of place and of time were in Greece, as we ſee, a matter of neceſſity, not of choice; and it is eaſy to ſhow, that if we ſubmit to ſuch fetters, it muſt be from choice, not neceſſity. This will be evident upon taking a view of the conſtitution of our drama which differs widely from that of Greece; whether more or leſs perfect, is a different point, to be handled afterward. By dropping the chorus, opportunity is afforded to divide the repreſentation by intervals of time, during which the ſtage is evacuated and the ſpectacle ſuſpended. This qualifies our drama for ſubjects ſpread through a wide ſpace both of time and of place: the time ſuppoſed to paſs during the ſuſpenſion of the repreſentation is not meaſured by the time of the ſuſpenſion; and any place may be ſuppoſed, as it is not in ſight: by which means many ſubjects can juſtly be repreſented in our theatres, that were excluded from thoſe of ancient Greece. This doctrine may be illuſtrated, by comparing a modern play to a ſet of hiſtorical pictures; let us ſuppoſe them five in number, and the reſemblance will be complete: each of the pictures reſembles an act in one of our plays: there muſt neceſſarily be the ſtricteſt unity of place and of time in each picture; and the ſame neceſſity requires theſe two unities during each act of a play, becauſe during an act there is no interruption in the ſpectacle. Now, when we view in ſucceſſion a number of ſuch hiſtorical pictures, let it be, for example, the hiſtory of Alexander by Le Brun, we have no difficulty to conceive, that months or years have paſſed between the events exhibited in two different pictures, though the interruption is imperceptible in paſſing our eye from the one to the other; and we have as little difficulty to conceive a change of place, however great: in which view, there is truly no difference between five acts of a modern play and five ſuch pictures. Where the repreſentation is ſuſpended we can with the greateſt facility ſuppoſe any length of time or any change of place: the ſpectator, it is true, may be conſcious, that the real time and place are not the ſame with what are employed in the repreſentation; but this is a work of reflection; and by the ſame reflection he may alſo be conſcious, that Garrick is not King Lear, that the playhouſe is not Dover cliffs, nor the noiſe he hears thunder and lightning. In a word, after an interruption of the repreſentation, it is not

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more difficult for a ſpectator to imagine a new place, or a different time, than, at the commencement of the play, to imagine himſelf at Rome, or in a period of time two thouſand years back. And indeed it is abundantly ridiculous, that a critic, who is willing to hold candle-light for ſun-ſhine, and ſome painted canvaſſes for a palace or a priſon, ſhould affect ſo much difficulty in imagining a latitude of place or of time in the fable, beyond what is neceſſary in the repreſentation.

106 Great latitude in time, however, not to be indulged,

There are, it muſt be acknowledged, ſome effects of great latitude in time that ought never to be indulged in a compoſition for the theatre: nothing can be more abſurd, than at the cloſe to exhibit a full-grown perſon who appears a child at the beginning: the mind rejects, as contrary to all probability, ſuch latitude of time as is requiſite for a change ſo remarkable. The greateſt change from place to place hath not altogether the ſame bad effect: in the bulk of human affairs place is not material; and the mind, when occupied with an intereſting event, is little regardful of minute circumſtances: theſe may be varied at will, becauſe they ſcarce make any impreſſion.

107 Nor in place.

At the ſame time, it is not here meant to juſtify liberty without any reſerve. An unbounded licence with relation to place and time, is faulty, for a reaſon that ſeems to have been overlooked, which is, that it ſeldom fails to break the unity of action; in the ordinary courſe of human affairs, ſingle events, ſuch as are fit to be repreſented on the ſtage, are confined to a narrow ſpot, and generally employ no great extent of time: we accordingly ſeldom find ſtrict unity of action in a dramatic compoſition, where any remarkable latitude is indulged in theſe particulars. It may even be admitted, that a compoſition which employs but one place, and requires not a greater length of time than is neceſſary for the repreſentation, is ſo much the more perfect; becauſe the confining an event within ſo narrow bounds, contributes to the unity of action, and alſo prevents that labour, however ſlight, which the mind muſt undergo in imagining frequent changes of place, and many intervals of time. But ſtill we muſt inſiſt, that ſuch limitation of place and time as was neceſſary in the Grecian drama, is no rule to us; and therefore, that though ſuch limitation adds one beauty more to the compoſition, it is at beſt but a refinement, which may juſtly give place to a thouſand beauties more ſubſtantial. And we may add, that it is extremely difficult, if not impracticable, to contract within the Grecian limits any fable ſo fruitful of incidents in number and variety as to give full ſcope to the fluctuation of paſſion.

Elem. of Criticiſm, ch. 23.

It may now appear, that critics who put the unities of place and of time upon the ſame footing with the unity of action, making them all equally eſſential, have not attended to the nature and conſtitution of the modern drama. If they admit an interrupted repreſentation, with which no writer finds fault, it is abſurd to reject its greateſt advantage, that of repreſenting many intereſting ſubjects excluded from the Grecian ſtage. If there needs muſt be a reformation, why not reſtore the ancient chorus and the ancient continuity of action? There is certainly no medium; for to admit an interruption without relaxing from the ſtrict unities of place and of time, is in effect to load us with all the inconveniences of the ancient drama, and at the ſame time to with-hold from us its advantages.

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108 Whether our drama be preferable to that of Greece.

And therefore the only proper queſtion is, Whether our model be or be not a real improvement? This indeed may fairly be called in queſtion; and in order to a comparative trial ſome particulars muſt be premiſed. When a play begins, we have no difficulty to adjuſt our imagination to the ſcene of action, however diſtant it be in time or in place; becauſe we know that the play is a repreſentation only. The caſe is very different after we are engaged: it is the perfection of repreſentation to hide itſelf, to impoſe on the ſpectator, and to produce in him an impreſſion of reality, as if he were ſpectator of a real event; but any interruption annihilates that impreſſion, by rouſing him out of his waking dream, and unhappily reſtoring him to his ſenſes. So difficult it is to ſupport the impreſſion of reality, that much ſlighter interruptions than the interval between two acts are ſufficient to diſſolve the charm: in the 5th act of the *Mourning Bride*, the three firſt ſcenes are in a room of ſtate, the fourth in a priſon; and the change is operated by ſhifting the ſcene, which is done in a trice: but however quick the tranſition may be, it is impracticable to impoſe upon the ſpectators ſo as to make them conceive that they are actually carried from the palace to the priſon; they immediately reflect, that the palace and priſon are imaginary, and that the whole is a fiction.

From theſe premiſes one will naturally be led, at firſt view, to pronounce the frequent interruptions in the modern drama to be an imperfection. It will occur, "That every interruption muſt have the effect to baniſh the dream of reality, and with it to baniſh our concern, which cannot ſubſiſt while we are conſcious that all is a fiction; and therefore, that in the modern drama, ſufficient time is not afforded for fluctuation and ſwelling of paſſion, like what is afforded in that of Greece, where there is no interruption." This reaſoning, it muſt be owned, has a ſpecious appearance: but we muſt not become faint-hearted upon the firſt repulſe; let us rally our troops for a ſecond engagement.

On the Greek ſtage, whatever may have been the caſe on the Roman, the repreſentation was never interrupted, and the diviſion by acts was totally unknown. The word *act* never once occurs in Ariſtotle's Poetics, in which he defines exactly every part of the drama, and divides it into the beginning, the middle, and the end. At certain intervals indeed the actors retired; but the ſtage was not then left empty, nor the curtain let fall; for the chorus continued and ſung. Neither do theſe ſongs of the chorus divide the Greek tragedies into five portions, ſimilar to our acts; though ſome of the commentators have endeavoured to force them into this office. But it is plain, that the intervals at which the chorus ſung are extremely unequal and irregular, ſuited to the occaſion and the ſubject; and would divide the play ſometimes into three, ſometimes into ſeven or eight acts.

As practice has now eſtabliſhed a different plan on the modern ſtage, has divided every play into five acts, and made a total pauſe in the repreſentation at the end of each act, the queſtion to conſidered is, Whether the plan of the ancient or of the modern drama is beſt qualified for making a deep impreſſion on the mind? That the preference is due to the plan of the modern drama, will be evident from the following conſiderations. If it be indeed true, as the advocates for the three unities allege, that the audience is deluded into the belief of the reality of a well-acted tragedy, it is certain that this deluſion cannot be long ſupported; for when the ſpirits are exhauſted by cloſe atention, and by the agitation of paſſion, an uneaſineſs enſues, which never fails to baniſh the waking dream. Now ſuppoſing the time that a man can employ with ſtrict attention without wandering to be no greater than is requiſite for a ſingle act (a ſuppoſition that cannot be far from truth), it follows, that a continued repreſentation of longer endurance than an act, inſtead of giving ſcope to fluctuation and ſwelling of paſſion, would overſtrain the attention, and produce a total abſence of mind. In this reſpect, the four pauſes have a fine effect: for by affording to the audience a ſeaſonable reſpite when the impreſſion of reality is gone, and while nothing material is in agitation, they relieve the mind from its fatigue; and conſequently prevent a wandering of thought at the very time poſſibly of the moſt intereſting ſcenes.

In one article, indeed, the Grecian model has greatly the advantage; its chorus, during an interval, not only preſerves alive the impreſſions made upon the audience, but alſo prepares their hearts finely for new impreſſions. In our theatres, on the contrary the audience, at the end of every act, being left to trifle time away, loſe every warm impreſſion; and they begin the next act cool and unconcerned, as at the commencement of the repreſentation. This is a groſs malady in our theatrical repreſentations; but a malady that luckily is not incurable: to revive the Grecian chorus, would be to revive the Grecian ſlavery of place and time; but we can figure a detached chorus coinciding with a pauſe in the repreſentation, as the ancient chorus did with a pauſe in the principal action. 109 An improvement of the modern drama ſuggeſted. Elem. of Criticiſm, ch. 23. What objection, for example, can there lie againſt muſic between the acts, vocal and inſtrumental, adapted to the ſubject? Such detached chorus, without putting us under any limitation of time or place, would recruit the ſpirits, and would preſerve, entire the tone, if not the tide, of paſſion: the muſic, after an act, ſhould commence in the tone of the preceding paſſion, and be gradually varied till it accord with the tone of the paſſion that is to ſucceed in the next act. The muſic and the repreſentation would both of them be gainers by their conjunction; which will thus appear. Muſic that accords with the preſent tone of mind, is, on that account, doubly agreeable; and accordingly, though muſic ſingly hath not power to raiſe a paſſion, it tends greatly to ſupport a paſſion already raiſed. Farther, muſic prepares us for the paſſion that follows. By making cheerful, tender, melancholy, or animated impreſſions, as the ſubject requires. Take for an example the firſt ſcene of the *Mourning Bride*, where ſoft muſic, in a melancholy ſtrain, prepares us for Almeria's deep diſtreſs. In this manner, muſic and repreſentation ſupport each other delightfully; the impreſſion made upon the audience by the repreſentation, is a fine preparation for the muſic that ſucceeds; and the impreſſion made by the muſic, is a fine preparation for the repreſentation that ſucceeds. It appears evident, that by ſome ſuch contrivance, the modern drama may be improved, ſo as to enjoy the advantage of the ancient chorus without its ſlaviſh limitation of place and time. But to return to the compariſon between the ancient and the modern drama.

The numberleſs improprieties forced upon the Greek dramatic poets by the conſtitution of their drama, may be ſufficient, one ſhould think, to make us prefer the modern drama, even abſtracting from the improvement propoſed. To prepare the reader for this article, it 110 The modern drama preferable to the ancient. muſt be premiſed, that as in the ancient drama the place of action never varies, a place neceſſarily muſt be choſen to which every perſon may have acceſs without any improbability. This confines the ſcene to ſome open place, generally the court or area before a palace; which excludes from the Grecian theatre tranſactions within doors, though theſe commonly are the moſt important. Such cruel reſtraint is of itſelf ſufficient to cramp the moſt pregnant invention; and accordingly the Greek writers, in order to preſerve unity of place, are reduced to woful improprieties. In the *Hippolytus* of Euripides (act 1. ſc. 6.), Phedra, diſtreſſed in mind and body, is carried without any pretext from her palace to the place of action; is there laid upon a couch, unable to ſupport herſelf upon her limbs; and made to utter many things improper to be heard by a number of women who form the chorus: and what is ſtill more improper, her female attendant uſes the ſtrongeſt intreaties to make her reveal the ſecret cauſe of anguiſh; which at laſt Phedra, contrary to decency and probability, is prevailed upon to do in preſence of that very chorus (act 2. ſc. 2.) Alceſtes, in Euripides, at the point of death, is brought from the palace to the place of action, groaning and lamenting her untimely fate (act 2. ſc. 1.) In the *Trachiniæ* of Sophocles (act. 2.), a ſecret is imparted to Dejanira, the wife of Hercules, in preſence of the chorus. In the tragedy of *Iphigenia*, the meſſenger employed to inform Clytemneſtra that Iphigenia was ſacrificed, ſtops ſhort at the place of action, and with a loud voice calls the queen from her palace to hear the news. Again, in the *Iphigenia in Tauris* (act 4.), the neceſſary preſence of the chorus forces Euripides into a groſs abſurdity, which is to form a ſecret in their hearing; and, to diſguiſe the abſurdity, much court is paid to the chorus, not one woman but a number, to engage them to ſecrecy. In the *Medea* of Euripides, that princeſs makes no difficulty, in preſence of the chorus, to plot the death of her huſband, of his miſtreſs, and of her father the king of Corinth, all by poiſon: it was neceſſary to bring Medea upon the ſtage; and there is but one place of action, which is always occupied by the chorus. This ſcene cloſes the ſecond act; and in the end of the third, ſhe frankly makes the chorus her confidents in plotting the murder of her own children. Terence, by identity of place, is often forced to make a converſation within doors be heard on the open ſtreet: the cries of a woman in labour are there heard diſtinctly.

111 Inconveniences of the plan of the ancient drama.

The Greek poets are not leſs hampered by unity of time than by that of place. In the *Hippolytus* of Euripides, that prince is baniſhed at the end of the 4th act; and in the firſt ſcene of the following act, a meſſenger relates to Theſeus the whole particulars of the death of Hippolytus by the ſea monſter: that remarkable event muſt have occupied many hours; and yet in the repreſentation it is confined to the time employed by the chorus upon the ſong at the end of the 4th act. The inconſiſtency is ſtill greater in the *Iphigenia in Tauris* (act 5. ſc. 4.): the ſong could not exhauſt half an hour; and yet the incident ſuppoſed to have happened during that time could not naturally have been tranſacted in leſs than half a day.

The Greek artiſts are forced, not leſs frequently, to tranſgreſs another rule, derived alſo from a continued repreſentation. The rule is, that as a vacuity, however momentary, interrupts the repreſentation, it is neceſſary that the place of action be conſtantly occupied. Sophocles, with regard to that rule as well as to others, is generally correct: but Euripides cannot bear ſuch reſtraint; he often evacuates the ſtage and leaves it empty for others. Iphigenia in Tauris, after pronouncing a ſoliloquy in the firſt ſcene, leaves the place of action, and is ſucceeded by Oreſtes and Pylades: they, after ſome converſation, walk off; and Iphigenia re-enters, accompanied with the chorus. In the Alceſtes, which is of the ſame author, the place of action is void at the end of the third act. It is true, that to cover the irregularity, and to preſerve the repreſentation in motion, Euripides is careful to fill the ſtage without loſs of time: but this ſtill is an interruption, and a link of the chain broken: for during the change of the actors, there muſt be a ſpace of time, during which the ſtage is occupied by neither ſet. It makes indeed a more remarkable interruption, to change the place of action as well as the actors; but that was not practicable upon the Grecian ſtage.

It is hard to ſay upon what model Terence has formed his plays. Having no chorus, there is a pauſe in the repreſentation at the end of every act: but advantage is not taken of the ceſſation, even to vary the place of action; for the ſtreet is always choſen, where every thing paſſing may be ſeen by every perſon; and by that choice, the moſt ſprightly and intereſting parts of the action, which commonly paſs within doors, are excluded; witneſs the laſt act of the *Eunuch*. He hath ſubmitted to the like ſlavery with reſpect to time. In a word, a play with a regular chorus, is not more confined in place and time than his plays are. Thus a zealous ſectary follows implicitly ancient forms and ceremonies, without once conſidering whether their introductive cauſe be ſtill ſubſiſting. Plautus, of a bolder genius than Terence, makes good uſe of the liberty afforded by an interrupted repreſentation: he varies the place of action upon all occaſions, when the variation ſuits his purpoſe.

Elem. of Criticiſm, chap. 23.

112
No change of time or place to be admitted but between the acts.

The intelligent reader will by this time underſtand, that we plead for no change of place in our plays but after an interval, nor for any latitude in point of time but what falls in with an interval. The unities of place and time ought to be ſtrictly obſerved during each act; for during the repreſentation there is no opportunity for the ſmalleſt deviation from either. Hence it is an eſſential requiſite, that during an act the ſtage be always occupied; for even a momentary vacuity makes an interval or interruption. Another rule is no leſs eſſential: it would be a groſs breach of the unity of action to exhibit upon the ſtage two ſeparate actions at the ſame time; and therefore, to preſerve that unity, it is neceſſary that each perſonage introduced during an act be linked to thoſe in poſſeſſion of the ſtage, ſo as to join all in one action. Theſe things follow from the very conception of an act, which admits not the ſlighteſt interruption: the moment the repreſentation is intermitted, there is an end of that act; and we have no other notion of a new act, but where, after a pauſe or interval, the repreſentation is again put in motion. French writers, generally ſpeaking, are correct in this particular. The Engliſh, on the contrary, are ſo irregular as ſcarce to deſerve a criticiſm: actors not only ſucceed each other in the ſame place without connection, but, what is ſtill leſs excuſable, they frequently ſucceed each other in different places. This change of place in the ſame act ought never to be indulged; for, beſide breaking the unity of the act, it has a diſagreeable effect: after an interval, the imagination adapts itſelf to any place that is neceſſary, as readily as at the commencement of the play: but during the repreſentation we reject change of place. From the foregoing cenſure muſt be excepted the *Mourning Bride* of Congreve, where regularity concurs with the beauty of ſentiment and of language, to make it one of the moſt complete pieces England has to boaſt of. It is to be acknowledged, however, that in point of regularity this elegant performance is not altogether unexceptionable. In the four firſt acts, the unities of place and time are ſtrictly obſerved: but in the laſt act, there is a capital error with reſpect to unity of place; for in the three firſt ſcenes of that act, the place of action is a room of ſtate, which is changed to a priſon in the fourth ſcene: the chain alſo of the actors is broken; as the perſons introduced in the priſon are different from thoſe who made their appearance in the room of ſtate. This remarkable interruption of the repreſentation makes in effect two acts inſtead of one: and therefore, if it be a rule that a play ought not to conſiſt of more acts than five, this performance is ſo far defective in point of regularity. It may be added, that, even admitting ſix acts, the irregularity would not be altogether removed, without a longer pauſe in the repreſentation than is allowed in the acting; for more than a momentary interruption is requiſite for enabling the imagination readily to fall in with a new place, or with a wide ſpace of time. In *The Way of the World*, of the ſame author, unity of place is preſerved during every act, and a ſtricter unity of time during the whole play than is neceſſary.

§ 4. *Of the Opera.*

113
The opera a drama repreſented by muſic.

AN opera is a drama repreſented by muſic. This entertainment was invented at Venice. An exhibition of this ſort requires a moſt brilliant magnificence, and an expence truly royal The drama muſt neceſſarily be compoſed in verſe; for as operas are ſung and accompanied with ſymphonies, they muſt be in verſe to be properly applicable to muſic. To render this entertainment ſtill more brilliant it is ornamented with dances and ballettes, with ſuperb decorations, and ſurpriſing machinery. The dreſſes of the actors, of thoſe who aſſiſt in the chorus, and of the dancers, being all in the moſt ſplended and elegant taſte, contribute to render the exhibition highly ſumptuous. But notwithſtanding this union of arts and pleaſures at an immenſe expenſe, and notwithſtanding a moſt dazzling pageantry, an opera appears, in the eyes of many people of taſte, but as a magnificent abſurdity, ſeeing that nature is never there from the beginning to the end. It is not our buſineſs here, however, to determine between the different taſtes of mankind.

The method of expreſſing our thoughts by ſinging and muſic is ſo little natural, and has ſomething in it ſo forced and affected, that it is not eaſy to conceive

Bielfield's Elem. of Erudition.

how it could come into the minds of men of genius to repreſent any human action, and, what is more, a ſerious or tragic action, any otherwiſe than by ſpeech. We have, it is true, operas in Engliſh by Addiſon, &c. in Italian by Metaſtatio, in French by M. Quinault. Fontenelle, &c. the ſubjects of which are ſo grave and tragic, that one might call them muſical tragedies, and real *chefs d'œuvres* in their kind. But though we are highly ſatisfied and greatly affected on reading them, and are much pleaſed with ſeeing them repreſented, yet the ſpectator is, perhaps, more charmed with the magnificence of the ſight and the beauty of the muſic, than moved with the action and the tragical part of the performance. We are not, however, of that order of critics who ſtrive to prove, that mankind act wrong in finding pleaſure in an object with which they are really pleaſed; who blame a lover for thinking his miſtreſs charming, when her features are by no means regular; and who are perpetually applying the rules of logic to the works of genius: we make theſe obſervations merely in order to examine if it be not poſſible to augment the pleaſures of a polite people, by making the opera ſomething more natural, more probable, and more conſonant to reaſon.

114 Should take its ſubject not from hiſtory but from fable and enchantment.

We think, therefore, that the poet ſhould never, or at leaſt very rarely, chooſe a ſubject from hiſtory, but from fable or mythology, or from the regions of enchantment. Every rational mind is conſtantly ſhocked to hear a mutilated hero trill out, from the ſlender pipe of a chaffinch, *To arms! To arms!* and in the ſame tone animate his ſoldiers, and lead them to the aſſault; or harangue an aſſembly of grave ſenators, and ſometimes a whole body of people. Nothing can be more burleſque than ſuch exhibitions; and a man muſt be poſſeſſed of a very uncommon ſenſibility to be affected by them. But as we know not what was the language of the gods, and their manner of expreſſing themſelves, we are at liberty in that caſe to form what illuſions we pleaſe, and to ſuppoſe that they ſung to diſtinguiſh themſelves from mortals. Beſides, all the magic of decorations and machinery become natural, and even neceſſary, in theſe kinds of ſubjects; and therefore readily afford opportunity for all the pomp of theſe performances. The chorus, the dances, the ballettes, the ſymphonies and dreſſes, may likewiſe be all made to correſpond with ſuch ſubjects: nothing is here affected, abſurd, or unnatural. Whoever is poſſeſſed of genius, and is well acquainted with mythology, will there find an inexhauſtible ſource of ſubjects highly diverſified, and quite proper for the drama of an opera.

115 And ſhould repreſent its characters as conſiſtent.

We ſhall not ſpeak here of that ſort of muſic which appears to us the moſt proper for ſuch a drama, and of the ſeveral alterations of which we think it ſuſceptible, in order to make it more complete, and to adapt it to a more pathetic, more noble, and more natural expreſſion, as well in the recitatives as in the airs and chorus. (See Music). We have only here to conſider the buſineſs of the poet. He ſhould never loſe ſight of nature, even in the midſt of the greateſt fiction. A god, a demi-god, a renowned hero, ſuch for example as Renaud in *Armido*, a fairy, a genie, a nymph, or fury, &c. ſhould conſtantly be repreſented according to the characters we give them, and never be made to talk the language of a fop or a *petite maitreſſe*. The recitative, which is the ground-work of the dialogue, requires verſes that are free and not regular, ſuch as with a ſimple cadence approach the neareſt to common language. The airs ſhould not be forced into the piece nor improperly placed for the ſake of terminating a ſcene, or to diſplay the voice of a performer: they ſhould expreſs ſome ſentiment, or ſome precept, ſhort and ſtriking, or tender and affecting; or ſome ſimile lively and natural; and they ſhould ariſe of themſelves from a monologue, or from a ſcene between two perſons: prolixity ſhould here be particularly avoided, eſpecially when ſuch an air makes part of a dialogue; for nothing is more inſipid or diſguſtful than the countenances of the other actors who appear at the ſame time, whoſe ſilence is quite unmeaning, and who know not what to do with their hands and feet while the ſinger is ſtraining his throat. The verſe of all the airs ſhould be of the lyric kind, and ſhould contain ſome poetic image, or paint ſome noble paſſion, which may furniſh the compoſer with an opportunity of diſplaying his talents, and of giving a lively and affecting expreſſion to the muſic. A phraſe that is inanimated can never have a good effect in the performance, but muſt become inſipid and horribly tedious in the air. The trite ſimilies of of the Italians, of a ſtream that flows, or a bird that flies, &c. are no longer ſufferable. The ſame thing may be ſaid with regard to the chorus, which ſhould be equally natural and well adapted: it is here ſometimes a whole people, ſometimes the inhabitants of a peculiar country, and ſometimes warriors, nymphs, or prieſts, &c. who raiſe their voice to demand juſtice, to implore favour, or render a general homage. The action itſelf will furniſh the poet of genius with ideas, words, and the manner of diſpoſing them.

116 Unity of action neceſſary to the opera.

Laſtly, the opera being a performance calculated leſs to ſatisfy the underſtanding than to charm the ear and affect the heart, and eſpecially to ſtrike the ſight, the poet ſhould have a particular attention to that object, ſhould be ſkilled in the arts of a theatre, ſhould know how to introduce combats, ballettes, feaſts, games, pompous entries, ſolemn proceſſions, and ſuch marvellous incidents as occur in the heavens, upon earth, in the ſea, and even in the infernal regions: but all theſe matters demand a ſtrong character, and the utmoſt preciſion in the execution: for otherwiſe, the comic being a near neighbour to the ſublime, they will eaſily become ridiculous. The unity of action muſt certainly be obſerved in ſuch a poem, and all the incidental epiſodes muſt concur to the principal deſign; otherwiſe it would be a monſtrous chaos. It is impoſſible, however, ſcrupulouſly to obſerve the unity of time and place: though the liberty, which reaſon allows the poet in this reſpect, is not without bounds; and the leſs uſe he makes of it, the more perfect his poem will be. It is not perhaps impoſſible ſo to arrange the objects, that, in changing the decorations, the painter may conſtantly make appear ſome part of the principal decoration which characteriſes the ſituation of the ſcene, as the corner of a palace, at the end of a garden, or ſome avenue that leads to it, &c. But all this is liable to difficulties, end even to exceptions; and the art of the painter muſt concur in ſuch caſe with that of the poet. For the reſt, all the operas of Europe are at leaſt one third too long; eſpecially the Italian. The unity of action requires brevity; and ſatiety is in inſeparable from a diverſion

verſion that laſts full four hours, and ſometimes longer.

They have indeed endeavoured to obviate this inconvenience by dividing an opera into three, and even into five acts; but experience proves, that this diviſion, though judicious, is ſtill not ſufficient to relieve the wearied attention.

Sect. II. *Of Lyric Poetry.*

117 Origin of the ode.

The ode is very ancient, and was probably the firſt ſpecies of poetry. It had its ſource, we may ſuppoſe, from the heart, and was employed to expreſs, with becoming fervour and dignity, the grateful ſenſe man entertained of the bleſſings which daily flowed from God the fountain of all goodneſs: hence their harveſt hymns, and other devotional compoſitions of that kind.

But in proceſs of time it was employed, not only to praiſe the Almighty for bounties received, but to ſolicit his aid in time of trouble; as is plain from the odes written by king David and others, and collected by the Jewiſh Sanhedrim into the book of Pſalms, to be ſung at their faſts, feſtivals, and on other ſolemn occaſions. Nor was this practice confined to the Iſraelites only: other nations had their ſongs of praiſe and petitions of this ſort, which they preferred to their deities in time of public proſperity and public diſtreſs, as well as to thoſe heroes who diſtinguiſhed themſelves in arms. Even the American Indians, whoſe notions of religion are extremely confined, have their war-ſongs, which they ſing to this day.

118 Its freedom.

It is reaſonable to ſuppoſe that the awful purpoſe to which the ode was applied, gave riſe among the ancients to the cuſtom of invoking the muſes; and that the poets, in order to raiſe their ſentiments and language, ſo as to be acceptable to their deities, thought it expedient to ſolicit ſome divine aſſiſtance. Hence poets are ſaid to have been inſpired, and hence an unbounded liberty has been given to the ode; for the lyric poet, fired, as it were, with his ſubject, and borne away on the wings of gratitude, diſdains grammatical niceties and common modes of ſpeech, and often ſoars above rule, though not above reaſon. This freedom, however, conſiſts chiefly in ſudden tranſitions, bold digreſſions, and lofty excurſions. For the ancient poets, and even Pindar, the moſt daring and lofty of them all, has in his ſublimeſt flights, and amidſt all his rapture, preſerved harmony, and often uniformity in his verſification: but ſo great is the variety of his meaſures that the traces of ſameneſs are in a manner loſt; and this is one of the excellencies for which that poet is admired, and which, though ſeemingly devoid of art, requires ſo much that he has ſeldom been imitated with ſucceſs.

The ancients in their odes indulged ſuch a liberty of fancy, that ſome of their beſt poets not only make bold excurſions and digreſſions, but, having in their flights ſtarted ſome new and noble thought, they frequently purſue it, and never more return to their ſubject. But this looſe kind of ode, which ſeems to reject all method, and in which the poet, having juſt touched upon his ſubject, immediately diverts to another, we ſhould think blameable, were it lawful to call in queſtion the authority of thoſe great men who were our preceptors in this art. We may venture to affirm, however, that theſe compoſitions ſtand in no degree of compariſon with other odes of theirs; in which, after wandering from the ſubject in purſuit of new ideas ariſing from ſome of its adjuncts, and ranging wantonly, as it were, through a variety of matter, the poet is from ſome other circumſtance led naturally to his ſubject again; and, like a bee, having collected the eſſence of many different flowers, returns home, and unites them all in one uniform pleaſing ſweet.

119 The ſubjects of the ode.

The ode among the ancients ſignified no more than a ſong: but with the moderns, the ode and the ſong are conſidered as different compoſitions; the ode being uſually employed in grave and lofty ſubjects, and ſeldom ſung but on ſolemn occaſions.

The ſubjects moſt proper for the ode and ſong, Horace has pointed out in a few elegant lines.

Gods, heroes, conquerors, *Olympic* crowns.
Love's pleaſing cares, and the free joys of wine,
Are proper ſubjects for the lyric ſong.

To which we may add, that happineſs, the pleaſures of a rural life, and ſuch parts of morality as afford leſſons for the promotion of our felicity, and reflections on the conduct of life, are equally ſuitable to the ode. This both *Pindar* and *Horace* were ſo ſenſible of that many of their odes are ſeaſoned with theſe moral ſentences and reflections.

But who can number ev'ry ſandy grain
Waſh'd by *Sicilio*'s hoarſe-reſounding main?
Or who can *Theron*'s gen'rous works expreſs,
And tell how many hearts his bounteous virtues bleſs?
Ode to THERON.

And in another Olympic ode, inſcribed by the ſame poet to Diagoras of Rhodes (and in ſuch eſteem, that it was depoſited in the temple of Minerva, written in letters of gold), Pindar, after exalting them to the ſkies, concludes with this leſſon in life:

Yet as the gales of fortune various blow,
To-day tempeſtuous, and to-morrow fair,
Due bounds, ye Rhodians, let your tranſports know;
Perhaps to-morrow comes a ſtorm of care.
Weſt's PINDAR.

The man reſolv'd and ſteady to his truſt,
Inflexible to ill, and obſtinately juſt,
May the rude rabble's inſolence deſpiſe,
Their ſenſeleſs clamours and tumultuous cries;
The tyrant's fierceneſs he beguiles,
And the ſtern brow and the harſh voice defies,
And with ſuperior greatneſs ſmiles.
    Not the rough whirlwind, that deforms
Adria's black gulph, and vexes it with ſtorms,
The ſtubborn virtue of his ſoul can move;
Nor the red arm of angry Jove,
That flings the thunder from the ſky,
And gives it rage to roar, and ſtrength to fly.
Should the whole frame of nature round him break,
In ruin and confuſion hurl'd,
He unconcern'd would hear the mighty crack,
And ſtand ſecure amidſt a falling world.
HORACE.

M. Deſpreaux has given us a very beautiful and juſt deſcription of the ode in theſe lines.

> L'Ode avec plus d'éclat, & non moins d'énergie
> Elevant juſqu'au ciel ſon vol ambitieux,
> Entretient dans vers commerce avec les Dieux.
> Aux Athletes dans Piſe elle ouvre la barriere,
> Chante un vainqueur poudreux au bout de la carriere;
> Mene Achille ſanglant au bords du Simois
> Ou fait flechir l'Eſcaut ſous le joug de Louïs.
> Tantôt comme une abeille ardente à ſon ouvrage
> Elle s'en va de fleurs dèpouiller le rivage:
> Elle peint les feſtins, les danſes & les ris,
> Vante un baiſer cueilli ſur les levres d'Iris,
> Qui mollement réſiſte & par un doux caprice
> Quelquefois le refuſe, afin qu'on le raviſſe.
> Son ſtyle impetueux ſouvent marche au haſard.
> Chez elle un beau deſordre eſt un effet de l'art,
> Loin ces rimeurs craintifs, dont l'eſprit phlegmatique
> Garde dans ſes fureurs un ordre didactique:
> Qui chantant d'un heros les progrès éclatans,
> Maigres hiſtoriens, ſuivront l'ordre des temps.
> Apollon de ſon feu leur fut toujours avare, &c.

> The lofty ode demands the ſtrongeſt fire,
> For there the muſe all Phœbus muſt inſpire:
> Mounting to heav'n in her ambitious flight,
> Amongſt the gods and heroes takes delight;
> Of Piſa's wreſtlers tells the ſinewy force,
> And ſings the duſty conqueror's glorious courſe;
> To Simois' banks now fierce Achilles ſends,
> Beneath the Gallic yoke now Eſcaut bends:
> Sometimes ſhe flies, like an induſtrious bee,
> And robs the flow'rs by nature's chemiſtry;
> Deſcribes the ſhepherds' dances, feaſts, and bliſs,
> And boaſts from Phillis to ſurpriſe a kiſs,
> When gently ſhe reſiſts with ſeign'd remorſe,
> That what ſhe grants may ſeem to be by force.
> Her generous ſtyle will oft at random ſtart,
> And by a brave diſorder ſhow her art;
> Unlike thoſe fearful poets whoſe cold rhyme
> In all their raptures keeps exacteſt time,
> Who ſing the illuſtrious hero's mighty praiſe,
> Dry journaliſts, by terms of weeks and days;
> To theſe, Apollo, thriſty of his fire,
> Denies a place in the Pierian choir, &c.
>
> SOAMES.

The variety of ſubjects, which are allowed the *lyric* poet, makes it neceſſary to conſider this ſpecies of poetry under the following heads, viz. the *ſublime* ode, the *leſſer* ode and the *ſong*. We ſhall begin with the loweſt, and proceed to that which is more eminent.

120
The ſong.

I. *Songs* are little poetical compoſitions, uſually ſet to a tune, and frequently ſung in company by way of entertainment and diverſion. Of theſe we have in our language a great number; but, conſidering that number, not many which are excellent; for, as the Duke of Buckingham obſerves,

> Though nothing ſeems more eaſy, yet no part
> Of poetry requires a nicer art.

The ſong admits of almoſt any ſubject; but the greateſt part of them turn either upon *love*, *contentment*, or the *pleaſures* of a *country life*, and *drinking*. Be the ſubject, however, what it will, the verſes ſhould be eaſy, natural, and flowing, and contain a certain harmony, ſo that poetry and muſic may be agreeably united. In theſe compoſitions, as in all others, obſcene and profane expreſſion ſhould be carefully avoided, and indeed every thing that tends to take off that reſpect which is due to religion and virtue, and to encourage vice and immorality. As the beſt ſongs in our language are already in every hand, it would ſeem ſuperfluous to inſert examples. For further precepts, however, as well as ſelect examples, in this ſpecies of compoſition, we may refer the reader to the elegant *Eſſay on Song Writing*, by Mr Aikin.

121
The diſtinguiſhing character of the leſſer ode.

II. The *leſſer ode*. The diſtinguiſhing character of this is ſweetneſs; and as the pleaſure we receive from this ſort of poem ariſes principally from its ſoothing and affecting the paſſions, great regard ſhould be paid to the language as well as to the thoughts and numbers.

> Th' expreſſion ſhould be eaſy, fancy high;
> Yet that not ſeem to creep, nor this to fly:
> No words tranſpos'd, but in ſuch order all,
> As, though hard wrought, may ſeem by chance to fall.
>
> *D. Buckingham's Eſſay.*

The ſtyle, indeed, ſhould be eaſy: but it may be alſo florid and figurative. It ſolicits delicacy, but diſdains affectation. The thoughts ſhould be natural, chaſte, and elegant; and the numbers various, ſmooth, and harmonious. A few examples will ſufficiently explain what we mean.

Longinus has preſerved a fragment of Sappho, an ancient Greek poeteſs, which is in great reputation amongſt the critics, and has been ſo happily tranſlated by Mr Philips as to give the Engliſh reader a juſt idea of the ſpirit, eaſe, and elegance of that admired author; and ſhow how exactly ſhe copied nature. To enter into the beauties of this ode, we muſt ſuppoſe a lover ſitting by his miſtreſs, and thus expreſſing his paſſion:

122
The Sapphic ode.

> Bleſt as th' immortal gods is he,
> The youth who fondly ſits by thee,
> And ſees and hears thee all the while
> Softly ſpeak, and ſweetly ſmile,
> 'Twas this deprived my ſoul of reſt,
> And rais'd ſuch tumults in my breaſt;
> For while I gaz'd, in tranſport toſt,
> My breath was gone, my voice was loſt.
> My boſom glow'd, the ſubtile ~~ſ~~lame fl
> Ran quick through all my vital frame:
> O'er my dim eyes a darkneſs hung;
> My ears with hollow murmurs rung.
> In dewy damps my limbs were chill'd;
> My blood with gentle horrors thrill'd;
> My feeble pulſe forgot to play;
> I fainted, ſunk, and dy'd away.

After this inſtance of the Sapphic ode, it may not be improper to ſpeak of that ſort of ode, which is called *Anacreontic*; being written in the manner and taſte of Anacreon, a Greek poet, famous for the delicacy of his wit, and the exquiſite, yet eaſy and natural, turn of his poeſy. We have ſeveral of his odes ſtill extant, and many modern ones in imitation of him, which are moſtly compoſed in verſes of ſeven ſyllables, or three feet and a half.

123
The Anacreontic ode.

We ſhall give the young ſtudent one or two examples of his manner from Mr Fawkes's excellent tranſlation.

The following ode on the power of gold, which had been often attempted but with little ſucceſs, this genteel man has tranſlated very happily.

Love's a pain that works our wo;
Not to love is painful too:
But, alas! the greateſt pain
Waits the love that meets diſdain.
What avails ingenuous worth,
Sprightly wit, or noble birth?
All theſe virtues uſeleſs prove;
Gold alone engages love.
May he be completely curſt.
Who the ſleeping miſchief firſt
Wak'd to life, and, vile before,
Stamp'd with worth the ſordid ore.
Gold creates in brethren ſtrife;
Gold deſtroys the parent's life;
Gold produces civil jars,
Murders, maſſacres, and wars;
But the worſt effect of gold,
Love, alas! is bought and ſold.

His ode on the vanity of riches is of a piece with the above, and conveys a good leſſon to thoſe who are over anxious for wealth.

If the treaſur'd gold could give
Man a longer term to live,
I'd employ my utmoſt care
Still to keep, and ſtill to ſpare;
And 'when death approach'd, would ſay,
' Take thy fee and walk away.'
But ſince riches cannot ſave
Mortals from the gloomy grave,
Why ſhould I myſelf deceive,
Vainly ſigh and vainly grieve?
Death will ſurely be my lot,
Whether I am rich or not.
Give me freely while I live
Generous wines, in plenty give
Soothing joys my life to cheer,
Beauty kind, and friends ſincere;
Happy! could I ever find
Friends ſincere, and beauty kind.

But two of the moſt admired, and perhaps the moſt imitated, of Anacreon's odes, are that of Mars wounded by one of the darts of Love, and Cupid ſtung by a Bee; both which are wrought up with fancy and delicacy, and are tranſlated with elegance and ſpirit.—Take that of Cupid, ſtung by a bee.

Once as Cupid, tir'd with play,
On a bed of roſes lay,
A rude bee, that ſlept unſeen,
The ſweet breathing buds between,
Stung his finger, cruel chance!
With its little pointed lance.
Straight he fills the air with cries
Weeps, and ſobs, and runs, and flies;
'Till the god to Venus came,
Lovely, laughter-loving dame;
Then he thus began to plain;
" Oh! undone——I die with pain—
" Dear mamma, a ſerpent ſmall,
" Which a bee the ploughmen call,
" Imp'd with wings, and arm'd with dart,
" Oh!—has ſtung me to the heart."
Venus thus reply'd, and ſmil'd;
' Dry thoſe tears for ſhame! my child;
' If a bee can wound ſo deep,
' Cauſing Cupid thus to weep,
' Think, O think! what cruel pains
' He that's ſtung by thee ſuſtains.'

124 Imitations of Anacreon and

Among the moſt ſucceſsful of this poet's Engliſh imitators may be reckoned Dr Johnſon and Mr Prior. The following ode on *Evening* by the former of theſe writers has, if we miſtake not, the very ſpirit and air of Anacreon.

Evening now from purple wings
Sheds the grateful gifts ſhe brings;
Brilliant drops bedeck the mead;
Cooling breezes ſhake the reed;
Shake the reed, and curl the ſtream
Silver'd o'er with Cynthia's beam;
Near the chequer'd lonely grove
Hears, and keeps thy ſecrets, Love.
Stella, thither let us ſtray!
Lightly o'er the dewy way.
Phœbus drives his burning car
Hence, my lovely Stella, far.
In his ſtead the queen of night
Round us pours a lambent light;
Light that ſeems but juſt to ſhow
Breaſts that beat, and cheeks that glow:
Let us now, in whiſper'd joy,
Evening's ſilent hours employ;
Silence beſt, and conſcious ſhades,
Pleaſe the hearts that love invades:
Other pleaſures give them pain;
Lovers all but love diſdain.

But of all the imitations of the playful bard of Greece that we have ever met with, the moſt perfect is the following Anacreontic by the regent Duke of Orleans.

I.
Je ſuis né pour les plaiſirs;
Bien fou qui s'en paſſe:
Je ne veux pas les choiſir;
Souvent le choix m'embarraſſe:
Aime t'on? J'aime ſoudain;
Bois t'on? J'ai le verre à la main;
Je tiens par tout ma place.
II.
Dormir eſt un temps perdu;
Faut il qu'on s'y livre?
Sommeil, prends ce qui t'eſt du;
Mais attends que je ſois yvre:
Saiſis moi dans cet inſtant;
Fais moi dormir promptement;
Je ſuis preſſé de vivre.
III.
Mais ſi quelque objet charmant,
Dans un ſonge aimable,
Vient d'un plaiſir ſeduiſant
M'offrir l'image agréable;
Sommeil, allons doucement;
L'erreur eſt en ce moment
Un bonheur veritable.

Tranſlation of the Regent's Anacreontic (E).

Frolic and free, for pleaſure born
The ſelf-denying fool I ſcorn:
The proffer'd joy I ne'er refuſe;
'Tis oft-times troubleſome to chuſe.
Lov'ſt thou, my friend? I love at ſight:
Drink'ſt thou? this bumper does thee right.
At random with the ſtream I flow
And play my part where'er I go.

Great God of Sleep, ſince we muſt be
Oblig'd to give ſome hours to thee,
Invade me not till the full bowl
Glows in my cheek, and warms my ſoul.
Be *that* the only time to ſnore,
When I can love and drink no more:
Short, very ſhort, then be thy reign;
For I'm in haſte to live again.

But, O! if melting in my arms,
In ſome ſoft dream, with all her charms,
The nymph belov'd ſhould then ſurpriſe,
And grant what waking ſhe denies;
Then prithee, gentle Slumber, ſtay;
Slowly, ah ſlowly, bring the day:
Let no rude noiſe my bliſs deſtroy;
Such ſweet deluſion's real joy.

125 Sappho, We have mentioned Prior as an imitator of Anacreon; but the reader has by this time had a ſufficient ſpecimen of Anacreontics. The following *Anſwer to Cloe jealous*, which was written when Prior was ſick, has much of the elegant tenderneſs of Sappho.

Yes, faireſt proof of beauty's pow'r,
  Dear idol of my panting heart,
Nature points this my fatal hour:
  And I have liv'd: and we muſt part.
While now I take my laſt adieu,
  Heave thou no ſigh, nor ſhed a tear;
Leſt yet my half-cloſ'd eye may view
  On earth an object worth its care.
From jealouſy's tormenting ſtrife
  For ever be thy boſom freed;
That nothing may diſturb thy life,
  Content I haſten to the dead.
Yet when ſome better-fated youth
  Shall with his am'rous parly move thee,
Reflect one moment on his truth
  Who, dying, thus perſiſts to love thee.

There is much of the ſoftneſs of Sappho, and the ſweetneſs of Anacreon and Prior, in the following ode, which is aſcribed to the late unfortunate Dr Dodd; and was written in compliment to a lady, who, being ſick, had ſent the author a moſs roſe-bud, inſtead of making his family a viſit. This piece is particularly to be eſteemed for the juſt and ſtriking moral with which it is pointed.

The ſlighteſt of favours beſtow'd by the fair,
With rapture we take, and with triumph we wear:
But a moſs-woven roſe-bud, Eliza, from thee,
A well-pleaſing gift to a monarch would be.
—Ah! that illneſs, too cruel, forbidding ſhould ſtand,
And refuſe me the gift from thy own lovely hand!
With joy I receive it, with pleaſure will view,
Reminded of thee, by its odour and hue:
"Sweet roſe, let me tell thee, tho' charming thy bloom,
Tho' thy fragrance excels Seba's richeſt perfume;
Thy breath to Eliza's no fragrance hath in't,
And but dull is thy bloom to her cheek's bluſhing tint.
Yet, alas! my fair flow'r, that bloom will decay,
And all thy lov'd beauties ſoon wither away;
Tho' pluck'd by her hand, to whoſe touch we muſt own,
Harſh and rough is the cignet's moſt delicate down:"
Thou too, ſnowy hand; nay, I mean not to preach;
But the roſe, lovely moraliſt, ſuffer to teach,
"Extol not, fair maiden, thy beauties o'er mine;
They too are ſhort-liv'd, and they too muſt decline;
And ſmall, in concluſion, the diff'rence appears,
In the bloom of few days, or the bloom of few years!
But remember a virtue the roſe hath to boaſt,
—Its fragrance remains when its beauties are loſt!"

We come now to thoſe odes of the more florid and figurative kind, of which we have many in our language that deſerve particular commendation. Mr Warton's Ode to Fancy has been juſtly admired by the beſt judges; for though it has a diſtant reſemblance of Milton's L'Allegro and Il Penſeroſo, yet the work is original; the thoughts are moſtly new and various, and the language and numbers elegant, expreſſive, and harmonious. 126 Odes more florid and figurative,

O parent of each lovely muſe,
Thy ſpirit o'er my ſoul diffuſe!
O'er all my artleſs ſongs preſide,
My footſteps to thy temple guide!
To offer at thy turf-built ſhrine
In golden cups no coſtly wine.
No murder'd fatling of the flock,
But flow'rs and honey from the rock.
O nymph, with looſely flowing hair,
With buſkin'd leg, and boſom bare;
Thy waiſt with myrtle-girdle bound,
Thy brows with Indian feathers crown'd;
Waving in thy ſnowy hand
An all-commanding magic wand,
Of pow'r to bid freſh gardens blow,
'Mid cheerleſs Lapland's barren ſnow;
Whoſe rapid wings thy flight convey,
Through air, and over earth and ſea;
While the vaſt various landſcape lies
Conſpicuous to thy piercing eyes.
O lover of the deſert, hail!
Say, in what deep and pathleſs vale,
Or on what hoary mountain's ſide,
Midſt falls of water, you reſide;
'Midſt broken rocks, a rugged ſcene,
With green and graſſy dales between;
'Midſt foreſts dark of aged oak,
Ne'er echoing with the woodman's ſtroke;

Where

(E) We give this tranſlation, both becauſe of its excellence and becauſe it is ſaid to have been the production of no leſs a man than the late Lord Chatham.

Where never human art appear'd,
Nor ev'n one ſtraw-roof'd cott was rear'd;
Where Nature ſeems to ſit alone,
Majeſtic on a craggy throne.
Tell me the path, ſweet wand'rer! tell,
To thy unknown ſequeſter'd cell,
Where woodbines cluſter round the door,
Where ſhells and moſs o'erlay the floor,
And on whoſe top an hawthorn blows,
Amid whoſe thickly-woven boughs
Some nightingale ſtill builds her neſt,
Each ev'ning warbling thee to reſt.
Then lay me by the haunted ſtream,
Wrapt in ſome wild poetic dream;
In converſe while methinks I rove
With Spenſer through a fairy grove;
Till ſuddenly awak'd, I hear
Strange whiſper'd muſic in my ear;
And my glad ſoul in bliſs is drown'd
By the ſweetly ſoothing ſound!
Me, goddeſs, by the right-hand lead,
Sometimes through the yellow mead;
Where Joy and white-rob'd Peace reſort,
And Venus keeps her feſtive court;
Where Mirth and Youth each ev'ning meet,
And lightly trip with nimble feet,
Nodding their lily-crowned heads;
Where Laughter roſs-lip'd Hebe leads;
Where Echo walks ſteep hills among,
Liſt'ning to the ſhepherd's ſong.
Yet not theſe flow'ry fields of joy
Can long my penſive mind employ;
Haſte, Fancy, from the ſcenes of Folly,
To meet the matron Melancholy!
Goddeſs of the tearful eye,
That loves to fold her arms and ſigh.
Let us with ſilent footſteps go
To charnels and the houſe of wo;
To Gothic churches, vaults, and tombs,
Where each ſad night ſome virgin comes,
With throbbing breaſt and faded cheek,
Her promis'd bridegroom's urn to ſeek:
Or to ſome abbey's mould'ring tow'rs,
Where, to avoid cold wintry ſhow'rs,
The naked beggar ſhivering lies,
While whiſtling tempeſts round her riſe,
And trembles leſt the tott'ring wall
Should on her ſleeping infants fall.
  Now let us louder ſtrike the lyre,
For my heart glows with martial fire:
I feel, I feel, with ſudden heat,
My big tumultuous boſom beat;
The trumpet's clangors pierce my ear,
A thouſand widow's ſhrieks I hear:
Give me another horſe, I cry;
Lo, the baſe Gallic ſquadrons fly!
Whence is this rage?—what ſpirit, ſay,
To battle hurries me away?
'Tis Fancy, in her fiery car,
Tranſports me to the thickeſt war;
There whirls me o'er the hills of ſlain,
Where tumult and deſtruction reign;
Where, mad with pain, the wounded ſteed,
Tramples the dying and the dead;
Where giant Terror ſtalks around,
With ſullen joy ſurveys the ground,
And pointing to th' enſanguin'd field,
Shakes his dreadful gorgon ſhield!
O guide me from this horrid ſcene
To high-arch'd walks and alleys green,
Which lovely Laura ſeeks, to ſhun
The fervours of the mid-day ſun.
The pangs of abſence, O remove,
For thou canſt place me near my love;
Can'ſt fold in viſionary bliſs,
And let me think I ſteal a kiſs;
While her ruby lips diſpenſe
Luſcious nectar's quinteſſence!
When young-ey'd Spring profuſely throws
From her green lap the pink and roſe;
When the ſoft turtle of the dale
To Summer tells her tender tale;
When Autumn cooling caverns ſeeks,
And ſtains with wine his jolly cheeks;
When Winter, like poor pilgrim old,
Shakes his ſilver beard with cold;
At ev'ry ſeaſon let my ear
Thy ſolemn whiſpers, Fancy, hear.
O warm enthuſiaſtic maid!
Without thy powerful, vital aid,
That breathes an energy divine,
That gives a ſoul to ev'ry line,
Ne'er may I ſtrive with lips profane,
To utter an unhallow'd ſtrain;
Nor dare to touch the ſacred ſtring,
Save when with ſmiles thou bid'ſt me ſing.
O hear our pray'r, O hither come
From thy lamented Shakeſpeare's tomb,
On which thou lov'ſt to ſit at eve,
Muſing o'er thy darling's grave.
O queen of numbers, once again
Animate ſome choſen ſwain,
Who, fill'd with unexhauſted fire,
May boldly ſmite the ſounding lyre;
Who with ſome new, unequal'd ſong,
May riſe above the rhyming throng;
O'er all our liſt'ning paſſions reign,
O'erwhelm our ſouls with joy and pain;
With terror ſhake, with pity move,
Rouze with revenge, or melt with love.
O deign t' attend his evening walk,
With him in groves and grottoes talk;
Teach him to ſcorn with frigid art,
Feebly to touch th' enraptur'd heart;
Like lightning, let his mighty verſe
The boſom's inmoſt foldings pierce;
With native beauties win applauſe,
Beyond cold critics ſtudied laws:
O let each-muſe's fame increaſe!
O bid Britannia rival Greece!

The following ode, written by Mr Smart on the 5th of December (being the birth-day of a beautiful young lady), is much to be admired for the variety and harmony of the numbers, as well as for the beauty of the thoughts and the elegance and delicacy of the compliment. It has great fire, and yet great ſweetneſs, and is the happy iſſue of genius and judgment united.

Of Lyric Poetry.

Hail eldeſt of the monthly train,
Sire of the winter drear,
December! in whoſe iron reign
Expires the chequer'd year.
Huſh all the bluſt'ring blaſts that blow,
And proudly plum'd in ſilver ſnow,
Smile gladly on this bleſt of days;
The livery'd clouds ſhall on thee wait,
And Phœbus ſhine in all his ſtate
With more than ſummer rays.
Though jocund June may juſtly boaſt
Long days and happy hours;
Though Auguſt be Pomona's hoſt,
And May be crown'd with flow'rs:
Tell June his fire and crimſon dies,
By Harriot's bluſh, and Harriot's eyes,
Eclips'd and vanquiſh'd, fade away;
Tell Auguſt, thou canſt let him ſee
A richer, riper fruit than he,
A ſweeter flow'r than May.

127
A paſtoral and elegiac ode.

The enſuing ode, written by Mr Collins on the death of Mr Thompſon, is of the paſtoral and elegiac kind, and both pictureſque and pathetic. To perceive all the beauties of this little piece, which are indeed many, we muſt ſuppoſe them to have been delivered on the river Thames near Richmond.

In yonder grave a Druid lies,
Where ſlowly winds the ſtealing wave;
The year's beſt ſweets ſhall duteous riſe
To deck its poet's ſilvan grave!
In yon deep bed of whiſp'ring reeds
His airy harp* ſhall now be laid,
That he, whoſe heart in ſorrow bleeds,
May love through life the ſoothing ſhade.
Then maids and youth ſhall linger here,
And, while its ſounds at diſtance ſwell,
Shall ſadly ſeem in pity's ear
To hear the woodland pilgrim's knell.
Reſemblance oft ſhall haunt the ſhore,
When Thames in ſummer wreaths is dreſt,
And oft ſuſpend the daſhing oar,
To bid his gentle ſpirit reſt!
And oft as eaſe and health retire
To breezy lawn, or foreſt deep,
The friend ſhall view yon whitening ſpire
And 'mid the varied landſcape weep.
But thou, who own'ſt that earthy bed,
Ah! what will ev'ry dirge avail?
Or tears, which love and pity ſhed,
That mourn beneath the gliding ſail?
Yet lives there one, whoſe heedleſs eye,
Shall ſcorn thy pale ſhrine glimm'ring near?
With him, ſweet bard, may fancy die,
And joy deſert the blooming year.
But thou, lorn ſtream, whoſe ſullen tide
No ſedge-crown'd ſiſters now attend,
Now waft me from the green hill's ſide,
Whoſe cold turf hides the buried friend.
And ſee, the fairy valleys fade,
Dim night has veil'd the ſolemn view!
Yet once again, dear parted ſhade,
Meek nature's child, again adieu!
The genial meads, aſſign'd to bleſs
Thy life, ſhall mourn thy early doom;
Their hinds, and ſhepherd girls, ſhall dreſs,
With ſimple hands, thy rural tomb.
Long, long, thy ſtone and pointed clay
Shall melt the muſing Briton's eyes;
O vales and wild woods, ſhall he ſay,
In yonder grave your Druid lies!

* The harp of Æolus.

† Richmond church.

Of Lyric Poetry.

128
The hymn.

Under this ſpecies of the ode, notice ought to be taken of thoſe written on divine ſubjects, and which are uſually called *hymns*. Of theſe we have many in our language, but none perhaps that are ſo much admired as Mr Addiſon's. The beauties of the following hymn are too well known, and too obvious, to need any commendation; we ſhall only obſerve, therefore that in this hymn (intended to diſplay the power of the Almighty) he ſeems to have had a pſalm of David in his view, which ſays, that "the heavens declare the glory of God, and the firmament ſheweth his handywork."

The ſpacious firmament on high,
With all the blue etherial ſky,
And ſpangled heav'ns, a ſhining frame,
Their great original proclaim:
Th' unwearied ſun, from day to day,
Does his Creator's pow'r diſplay,
And publiſhes to ev'ry land
The work of an Almighty hand.
Soon as the ev'ning ſhades prevail,
The moon takes up the wond'rous tale,
And nightly to the liſt'ning earth
Repeats the ſtory of her birth:
While all the ſtars that round her burn,
And all the planets in their turn,
Confirm the tidings as they roll,
And ſpread the truth from pole to pole.
What tho' in ſolemn ſilence all
Move round the dark terreſtrial ball?
What tho' nor real voice or ſound
Amid their radiant orbs be found?
In reaſon's ear they all rejoice,
And utter forth a glorious voice,
For ever ſinging as they ſhine,
"The hand that made us is divine."

The following paſtoral hymn is a verſion of the 23d *Pſalm* by Mr Addiſon; the peculiar beauties of which have occaſioned many tranſlations; but we have ſeen none that is ſo poetical and perfect as this. And in juſtice to Dr Boyce, we muſt obſerve, that the muſic he has adapted to it is ſo ſweet and expreſſive, that we know not which is to be moſt admired, the poet or the muſician.

The Lord my paſture ſhall prepare,
And feed me with a ſhepherd's care;
His preſence ſhall my wants ſupply,
And guard me with a watchful eye;
My noon-day walks he ſhall attend,
And all my midnight hours defend.
When in the ſultry glebe I faint,
Or on the thirſty mountain pant,
To fertile vales and dewy meads
My weary wand'ring ſteps he leads;
Where peaceful rivers ſoft and ſlow
Amid the verdant landſcape flow.
Tho' in the paths of death I tread,
With gloomy horrors overſpread,

My ſteadfaſt heart ſhall fear no ill:
For thou, O Lord, art with me ſtill;
Thy friendly crook ſhall give me aid,
And guide me through the dreadful ſhade.
Tho' in a bare and rugged way,
Through devious lonely wilds I ſtray,
Thy bounty ſhall my pains beguile:
The barren wilderneſs ſhall ſmile,
With ſudden greens and herbage crown'd;
And ſtreams ſhall murmur all around.

129 The ſublime ode. III. We are now to ſpeak of theſe odes which are of the ſublime and noble kind, and diſtinguiſhed from others by their elevation of thought and diction, as well by the variety or irregularity of their numbers; as the frequent tranſitions and bold excurſions with which they are enriched.

To give the young ſtudent an idea of the ſudden and frequent tranſitions, digreſſions, and excurſions, which are admitted into the odes of the ancients, we cannot do better than refer him to the celebrated ſong or ode of Moſes which is the oldeſt that we know of, and was penned by that divine author immediately after the children of Iſrael croſſed the Red-Sea.

At the end of this ſong, we are told, that "Miriam the propheteſs, the ſiſter of Aaron, took a timbrel in her hand, and all the women went out after her with timbrels and with dances. And Miriam anſwered them, Sing ye to the Lord, for he hath triumphed gloriouſly: the horſe and his rider hath he thrown into the ſea."

From this laſt paſſage it is plain, that the ancients very early called in muſic to the aid of poetry; and that their odes were uſually ſung and accompanied with their lutes, harps, lyres, timbrels, and other inſtruments: nay, ſo eſſential, and in ſuch reputation, was muſic held by the ancients, that we often find in their lyric poets, addreſſes or invocations to the harp, the lute, or the lyre? and it was probably owing to the frequent uſe made of the laſt-mentioned inſtrument with the ode, that this ſpecies of writing obtained the name of *Lyric poetry*.

This ode, or hymn, which ſome believe was compoſed by Moſes in Hebrew verſe, is incomparably better than any thing the heathen poets have produced of the kind, and is by all good judges conſidered as a maſterpiece of ancient eloquence. The thoughts are noble and ſublime: the ſtyle is magnificent and expreſſive: the figures are bold and animated: the tranſitions and excurſions are ſudden and frequent: but they are ſhort, and the poet, having digreſſed for a moment, returns immediately to the great object that excited his wonder, and elevated his ſoul with joy and gratitude. The images fill the mind with their greatneſs, and ſtrike the imagination in a manner not to be expreſſed.

If there be any thing that in ſublimity approaches to it, we muſt look for it in the eaſt, where perhaps we ſhall find nothing ſuperior to the following Hindoo hymn to *Narrayna*, or "the ſpirit of God," taken, as Sir William Jones informs us, from the writings of the ancient Bramins.

Spirit of ſpirits, who, through every part
Of ſpace expanded, and of endleſs time,
Beyond the reach of lab'ring thought ſublime,
Badſt uproar into beauteous order ſtart;
    Before heav'n was, thou art.
Ere ſpheres beneath us roll'd, or ſpheres above,
Ere earth in firmamental æther hung,
Thou ſat'ſt alone, till, through thy myſtic love,
Things unexiſting to exiſtence ſprung,
    And grateful deſcant ſung.
Omniſcient Spirit, whoſe all-ruling pow'r
Bids from each ſenſe bright emanations beam;
Glows in the rainbow, ſparkles in the ſtream,
Smiles in the bud, and gliſtens in the flow'r
    That crowns each vernal bow'r;
Sighs in the gale, and warbles in the throat
Of every bird that hails the bloomy ſpring,
Or tells his love in many a liquid-note,
Whilſt envious artiſts touch the rival ſtring,
    Till rocks and foreſts ring;
Breathes in rich fragrance from the Sandal grove,
Or where the precious muſk deer playful rove;
In dulcet juice, from cluſt'ring fruit diſtils,
And burns ſalubrious in the taſteful clove:
    Soft brinks and ver'drous hills
    Thy preſent influence fills;
In air, in floods, in caverns, woods, and plains,
Thy will inſpirits all, thy ſovereign Maya reigns.
Blue cryſtal vault, and elemental fires,
That in th' ethereal fluid blaze and breathe;
Thou, toſſing main, whoſe ſnaky branches wreathe
This penſile orb with intertwiſting gyres;
Mountains, whoſe lofty ſpires,
Preſumptuous, rear their ſummits to the ſkies,
And blend their em'rald hue with ſapphire light;
Smooth meads and lawns, that glow with varying dyes
Of dew-beſpangled leaves and bloſſoms bright,
Hence! vaniſh from my ſight
Deluſive pictures! unſubſtantial ſhows!
My ſoul abſorb'd one only Being knows,
Of all perceptions one abundant ſource,
Whence ev'ry object, ev'ry moment flows:
Suns hence derive their force,
Hence planets learn their courſe;
But ſuns and fading worlds I view no more;
God only I perceive; God only I adore (F).

130 The Pindaric ode. We come now to the *Pindaric ode*, which (if we except the hymns in the Old Teſtament, the pſalms of king David, and ſuch hymns of the Hindoos as that juſt quoted) is the moſt exalted part of Lyric poetry; and was ſo called from *Pindar*, an ancient Greek poet, who is celebrated for the boldneſs of his flights, the impetuoſity of his ſtyle, and the ſeeming wildneſs and irregularity that runs through his compoſitions, and which are ſaid to be the effect of the greateſt art. See PINDAR.

The odes of Pindar were held in ſuch high eſtimation by the ancients, that it was fabled, in honour of their ſweetneſs, that the bees, while he was in the cradle, brought

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(F) For the philoſophy of this ode, which repreſents the Deity as the ſoul of the world, or rather as the only Being (the το ἓν of the Greeks), ſee METAPHYSICS, n° 269. and PHILOSOPHY, n° 6.

brought honey to his lips: nor did the victors at the Olympic and other games think the crown a ſufficient reward for their merit, unleſs their atchievements were celebrated in Pindar's ſongs; moſt wiſely preſaging, that the firſt would decay, but the other endure for ever.

This poet did not always write his odes in the ſame meaſure, or with the ſame intention with regard to their being ſung. For the ode inſcribed to Diagoras (the concluding ſtanza of which we inſerted at the beginning of this ſection) is in heroic meaſure, and all the ſtanzas are equal: there are others alſo, as Mr Weſt obſerves, made up of *ſtrophes* and *antiſtrophes*, without any *epode*; and ſome compoſed of *ſtrophes* only, of different lengths and meaſures: but the greateſt part of his odes are divided into *ſtrophe*, *antiſtrophe*, and *epode*; in order, as Mr Congreve conjectures, to their being ſung and addreſſed by the performers to different parts of the audience. "They were ſung (ſays he) by a chorus, and adapted to the lyre, and ſometimes to the lyre and pipe. They conſiſted ofteneſt of three ſtanzas. The firſt was called the *ſtrophe*, from the verſion or circular motion of the ſingers in that ſtanza from the right hand to the left. The ſecond ſtanza was called the *antiſtrophe*, from the contraverſion of the chorus; the ſingers in performing that, turning from the left hand to the right, contrary always to their motion in the *ſtrophe*. The third ſtanza was called the *epode* (it may be as being the after-ſong), which they ſung in the middle, neither turning to one hand nor the other. But Dr Weſt's* friend is of opinion, that the performers alſo danced one way while they were ſinging the *ſtrophe*, and danced back as they ſung the *antiſtrophe*, till they came to the ſame place again, and then ſtanding ſtill they ſung the *epode*. He has tranſlated a paſſage from the *Scholia* on *Hephæſtion*, in proof of his opinion; and obſerves, that the dancing the *ſtrophe* and *antiſtrophe* in the ſame ſpace of ground, and we may ſuppoſe the ſame ſpace of time alſo, ſhows why thoſe two parts conſiſted of the ſame length and meaſure.

As the various meaſures of Pindar's odes have been the means of ſo far miſleading ſome of our modern poets as to induce them to call compoſitions Pindaric odes, that were not written in the method of Pindar it is neceſſary to be a little more particular on this head, and to give an example from that poet, the more effectually to explain his manner; which we ſhall take from the tranſlation of Dr Weſt.

The eleventh NEMEAN ODE.

This ode is inſcribed to Ariſtagoras, upon occaſion of his entering on his office of preſident or governor of the iſland of Tenedos: ſo that although it is placed among the Nemean odes, it has no ſort of relation to thoſe games, and is indeed properly an inauguration ode, compoſed to be ſung by a chorus at the ſacrifices and the feaſts made by Ariſtagoras and his colleagues, in the town-hall, at the time of their being inveſted with the magiſtracy, as is evident from many expreſſions in the firſt *ſtrophe* and *antiſtrophe*.

ARGUMENT.

Pindar opens this ode with an invocation to Veſta (the goddeſs who preſided over the courts of juſtice, and whoſe ſtatue and altar were for that reaſon placed in the town halls, or *Prytanæums*, as the Greeks called them), beſeeching her to receive favourably Ariſtagoras and his colleagues, who were then coming to offer ſacrifices to her, upon their entering on their office of Prytans or magiſtrates of Tenedos; which office continuing for a year, he begs the goddeſs to take Ariſtagoras under her protection during that time, and to conduct him to the end of it without trouble or diſgrace. From Ariſtagoras, Pindar turns himſelf in the next place to his father Arceſilas, whom he pronounces happy, as well upon account of his ſon's merit and honour, as upon his own great endowments and good fortune; ſuch as beauty, ſtrength, courage, riches, and glory, reſulting from his many victories in the games. But leſt he ſhould be too much puffed up with theſe praiſes, he reminds him at the ſame time of his mortality, and tells him that his clothing of fleſh is periſhable, that he muſt e'er long be clothed with earth, the *end of all things*: and yet, continues he, it is but juſtice to praiſe and celebrate the worthy and deſerving, who from good citizens ought to receive all kinds of honour and commendation; as Ariſtagoras, for inſtance, who hath rendered both himſelf and his country illuſtrious by the many victories he hath obtained, to the number of ſixteen, over the neighbouring youth, in the games exhibited in and about his own country. From whence, ſays the poet, I conclude he would have come of victorious even in the Pythian and Olympic games, had he not been reſtrained from engaging in thoſe famous liſts by the too timid and cautious love of his parents. Upon which he falls into a moral reflection upon the vanity of man's hopes and fears; by the former of which they are oftentimes excited to attempts beyond their ſtrength, which accordingly iſſue in their diſgrace; as, on the other hand, they are frequently reſtrained, by unreaſonable and ill-grounded fears, from enterpriſes, in which they would in all probability have come off with honour. This reflection he applies to Ariſtagoras, by ſaying it was very eaſy to foreſee what ſucceſs he was like to meet with who both by father and mother was deſcended from a long train of great and valiant men. But where again with a very artful turn of flattery to his father Arceſilas, whom he had before repreſented as ſtrong and valiant, and famous for his victories in the games, he obſerves that every generation, even of a great and glorious family, is not equally illuſtrious any more than the fields and trees are every year equally fruitful; that the gods had not given mortals any certain tokens by which they might foreknow when the *rich years of virtue ſhould ſucceed*; whence it comes to paſs, that men, out of ſelf-conceit and preſumption, are perpetually laying ſchemes, and forming enterpriſes, without previouſly conſulting prudence or wiſdom, whoſe *ſtreams*, ſays he, lie remote and out of the common road. From all which he infers, that it is better to moderate our deſires, and ſet bounds to our avarice and ambition; with which moral precept he concludes the ode.

STROPHE I.

Daughter of Rhea! thou, whoſe holy fire
Before the awful ſeat of juſtice flames!
Siſter of heav'n's almighty ſire!
Siſter of Juno, who coequal claims
With Jove to ſhare the empire of the gods!
O virgin Veſta! to thy dread abodes,

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*Vid. Pref. to Weſt's Pindar.

Lo! Ariſtagoras directs his pace!
Receive and near thy ſacred ſceptre place
Him and his colleagues, who, with honeſt zeal,
O'er Tenedos preſide, and guard the public weal.

Antistrophe I.

And lo! with frequent off'r'ngs, they adore
Thee*, firſt invok'd in ev'ry ſolemn pray'r!
To thee unmix'd libations pour,
And fill with od'rous fumes the fragrant air.
Around in feſtive ſongs the hymning choir
Mix the melodious voice and ſounding lyre,
While ſtill, prolong'd with hoſpitable love,
Are ſolemnized the rites of genial Jove:
Then guard him, Veſta through his long career
And let him cloſe in joy his miniſterial year.

Epode I.

But hail, Arceſilas! all hail
To thee, bleſs'd father of a ſon ſo great!
Thou whom on fortune's higheſt ſcale
The favourable hand of heav'n hath ſet,
Thy manly form with beauty hath refin'd,
And match'd that beauty with a valiant mind.
Yet let not man too much preſume,
Tho' grac'd with beauty's faireſt bloom:
Tho' for ſuperior ſtrength renown'd;
Tho' with triumphal chaplets crown'd:
Let him remember, that, in fleſh array'd,
Soon ſhall he ſee that mortal veſtment fade;
Till loſt impriſon'd in the mould'ring urn,
To earth, the end of all things, he return.

Strophe. II.

Yet ſhould the worthy from the public tongue
Receive the recompenſe of virtuous praiſe;
By ev'ry zealous patriot ſung,
And deck'd with ev'ry flow'r of heav'nly lays.
Such retribution in return for fame,
Such, Ariſtagoras, thy virtues claim,
Claim from thy country; on whoſe glorious brows
The wreſtler's chaplet ſtill unfaded blows;
Mix'd with the great Pancratiaſtic crown,
Which from the neighb'ring youth thy early valour won.

Antistrophe. II.

And (but his timid parents' cautious love,
Diſturbing ever his too forward hand,
Forbad their tender ſon to prove
The toils of Pythia or Olympia's ſands),
Now by the Gods I ſwear, his valorous might
Had 'ſcap'd victorious in each bloody fight;
And from Caſtalia†, or where dark with ſhade
The mount of Saturn ‡ rears its olive head,
Great and illuſtrious home had he return'd;
While, by his fame eclips'd, his vanquiſh'd foes had
[mourn'd.

Epode II.

Then his triumphal treſſes bound
With the dark verdure of th' Olympic grove,
With joyous banquets had he crown'd
The great quinquennial feſtival of Jove;
And cheer'd the ſolemn pomp with choral lays,
Sweet tribute, which the muſe to virtue pays.

But, ſuch is man's prepoſt'rous fate!
Now, with o'er-ween'ng pride elate,
Too far he aims his ſhaft to throw.
And ſtraining burſts his feeble bow:
Now puſillanimous depreſs'd with fear,
He checks his virtue in the mid career;
And of his ſtrength diſtruſtful, coward flies
The conteſt, tho' empow'rd to gain the prize.

Strophe III.

But who could err in propheſying good
Of him, whoſe undegenerating breaſt
Swells with a tide of Spartan blood,
From ſire to ſire in long ſucceſſion trac'd
Up to Piſander; who in days of yore
From old Amyclæ to the Leſbian ſhore
And Tenedos, colleagu'd in high command
With great Oreſtes, led th' Æolian band?
Nor was his mother's race leſs ſtrong and brave,
Sprung from a ſtock that grew on fair * Iſmenus' wave.

Antistrophe III.

Tho' for long intervals obſcur'd, again
Oft-times the ſeeds of lineal worth appear.
For neither can the furrow'd plain
Full harveſts yield with each returning year;
Nor in each period will the pregnant bloom
Inveſt the ſmiling tree with rich perfume.
So barren often, and inglorious paſs
The generations of a noble race;
While nature's vigour, working at the root,
In after-ages ſwells, and bloſſoms into fruit.

Epode III.

Nor hath Jove giv'n us to foreknow
When the rich years of virtue ſhall ſucceed:
Yet bold and daring on we go,
Contriving ſchemes of many a mighty deed;
While hope, fond inmate of the human mind,
And ſelf opinion, active, raſh, and blind,
Hold up a falſe illuſive ray,
That leads our dazzled feet aſtray
Far from the ſprings, where, calm and ſlow,
The ſecret ſtreams of wiſdom flow.
Hence ſhould we learn our ardour to reſtrain,
And limit to due bounds the thirſt of gain.
To rage and madneſs oft that paſſion turns,
Which with forbidden flames deſpairing burns.

131 Diſtinguiſhing characters of it.

From the above ſpecimen, and from what we have already ſaid on this ſubject, the reader will perceive, that odes of this ſort are diſtinguiſhed by the happy tranſitions and digreſſions which they admit, and the ſurpriſing yet natural returns to the ſubject. This requires great judgment and genius; and the poet who would excel in this kind of writing, ſhould draw the plan of his poem, in manner of the argument we have above inſerted, and mark out the places where thoſe elegant and beautiful ſallies and wanderings may be made, and where the returns will be eaſy and proper.

Pindar, it is univerſally allowed, had a poetical and fertile imagination, a warm and enthuſiaſtic genius, a bold and figurative expreſſion, and a conciſe and ſententious ſtyle; but it is generally ſuppoſed that many of thoſe pieces which procured him ſuch extravagant praiſes and extraordinary teſtimonies of eſteem from the ancients are loſt; and if they were not, it would be perhaps impoſſible to convey them into our language; for beauties of this kind, like plants of an odoriferous and delicate nature, are not to be tranſplanted into another clime without loſing much of their fragrance or eſſential quality.

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* It was uſual in all ſolemn ſacrifices and prayers to begin with invoking Veſta.

† A river upon whoſe banks the Pythian games were exhibited.

‡ A ſmall hill planted with olives, that overlooked the Stadium at Olympia.

* Iſmenus was a river of Bœotia, of which country was Menalippus, the anceſtor of Ariſtagoras by the mother's ſide.

132 Modern odes commonly called Pindaric.

With regard to thoſe compoſitions which are uſually called *Pindaric odes*, (but which ought rather to be diſtinguiſhed by the name of *irregular odes*), we have many in our language that deſerve particular commendation: and the criticiſm Mr Congreve has given us on that ſubject, has too much aſperity and too great latitude; for if other writers have, by miſtaking Pindar's meaſures, given their odes an improper title, it is a crime, one would think, not ſo dangerous to the commonwealth of letters as to deſerve ſuch ſevere reproof. Beſide which, we may ſuppoſe that ſome of theſe writers did not deviate from Pindar's method through ignorance, but by choice; and that as their odes were not to be performed with both ſinging and dancing, in the manner of Pindar's, it ſeemed unneceſſary to confine the firſt and ſecond ſtanzas to the ſame exact numbers as was done in his ſtrophes and antiſtrophes. The poet therefore had a right to indulge himſelf with more liberty: and we cannot help thinking, that the ode which Mr Dryden has given us, intitled, *Alexander's Feaſt*, or *the Power of Muſic*, is altogether as valuable in looſe and wild numbers, as it could have been if the ſtanzas were more regular, and written in the manner of Pindar. In this ode there is a wonderful ſublimity of thought, a loftineſs and ſweetneſs of expreſſion, and a moſt pleaſing variety of numbers.

'Twas at the royal feaſt, for Perſia won
By Philip's warlike ſon,
Aloft, in awful ſtate,
The god-like hero ſate
On his imperial throne:
His valiant peers were plac'd around:
Their brows with roſes and with myrtles bound,
(So ſhould deſert in arms be crown'd:)
The lovely Thais by his ſide
Sat like a blooming eaſtern bride,
In flow'r of youth and beauty's pride.
Happy, happy, happy pair!
None but the brave,
None but the brave,
None but the brave deſerve the fair.
Chor. *Happy, happy*, &c.
Timotheus, plac'd on high
Amid the tuneful quire,
With flying fingers touch the lyre:
The trembling notes aſcend the ſky,
And heav'nly joys inſpire.
The ſong began from Jove,
Who left his bliſsful ſeats above,
(Such is the pow'r of mighty love!)
A dragon's fiery form bely'd the God:
Sublime on radiant ſpires he rode,
When he to fair Olympia preſs'd;
And while he ſought her ſnowy breaſt:
Then round her ſlender waiſt he curl'd,
And ſtamp'd an image of himſelf, a ſov'reign of the world.
The liſt'ning crowd admire the lofty ſound.
A preſent deity, they ſhout around:
A preſent deity the vaulted roofs rebound:
With raviſh'd ears
The monarch hears,
Aſſumes the God,
Affects to nod,
And ſeems to ſhake the ſpheres.
Chor. *With raviſh'd ears*, &c.
The praiſe of Bacchus then the ſweet muſician ſung;
Of Bacchus ever fair and ever young:
The jolly God in triumph comes;
Sound the trumpets, beat the drums:
Fluſh'd with a purple grace,
He ſhows his honeſt face:
Now give the hautboys breath; he comes he comes!
Bacchus, ever fair and young,
Drinking joys did firſt ordain:
Bacchus' bleſſings are a treaſure,
Drinking is the ſoldier's pleaſure:
Rich the treaſure,
Sweet the pleaſure:
Sweet the pleaſure after pain.
Chor. *Bacchus' bleſſings*, &c.
Sooth'd with the ſound, the king grew vain,
Fought all his battles o'er again;
And thrice he routed all his foes, and thrice he ſlew the ſlain.
The maſter ſaw the madneſs riſe:
His glowing cheeks, his ardent eyes;
And while he heav'n and earth defy'd,
Chang'd his hand, and check'd his pride.
He choſe a mournful muſe
Soft pity to infuſe:
He ſung Darius great and good,
By too ſevere a fate,
Fallen, fallen, fallen, fallen,
Fallen from his high eſtate,
And welt'ring in his blood;
Deſerted at his utmoſt need,
By thoſe his former bounty fed,
On the bare earth expos'd he lies,
With not a friend to cloſe his eyes.
With down-caſt looks the joyleſs victor ſat,
Revolving in his alter'd ſoul
The various turns of chance below;
And now and then a ſigh he ſtole,
And tears began to flow,
Cho. *Revolving*, &c.
The mighty maſter ſmil'd to ſee
That love was in the next degree:
'Twas but a kindred ſound to move;
For pity melts the mind to love,
Softly ſweet, in Lydian meaſures:
Soon he ſooth'd his ſoul to pleaſures.
War, he ſung, is toil and trouble;
Honour but an empty bubble,
Never ending, ſtill beginning,
Fighting ſtill, and ſtill deſtroying.
If the world be worth thy winning,
Think, O think, it worth enjoying.
Lovely Thais ſits beſide thee,
Take the good the gods provide thee.
The many rend the ſkies with loud applauſe;
So love was crown'd, but muſic won the cauſe.
The prince, unable to conceal his pain,

Gaz'd on the fair,
Who caus'd his care,
And ſigh'd and look'd, ſigh'd and look'd,
Sigh'd and look'd, and ſigh'd again:
At length with love and wine at once oppreſs'd,
The vanquiſh'd victor ſunk upon her breaſt.
Chor. *The Prince*, &c.
Now ſtrike the golden lyre again;
A louder yet, and yet a louder ſtrain.
Break his bands of ſleep aſunder,
And rouſe him, like a rattling peal of thunder.
Hark! hark! the horrid ſound
Has rais'd up his head,
As awake from the dead,
And amaz'd he ſtares round.
Revenge, revenge, Timotheus cries,
See the furies ariſe:
See the ſnakes that they rear,
How they hiſs in their hair,
And the ſparkles that flaſh from their eyes;
Behold a ghaſtly band,
Each a torch in his hand!
Thoſe are Grecian ghoſts that in battle were ſlain,
And unbury'd remain,
Inglorious on the plain.
Give the vengeance due
To the valiant crew.
Behold how they toſs their torches on high,
How they point to the Perſian abodes,
And glitt'ring temples of their hoſtile gods.
The princes applaud with a furious joy;
And the king ſeiz'd a flambeau, with zeal to deſtroy;
Thais led the way
To light him to his prey,
And, like another Helen, ſhe fir'd another Troy.
Chor. *And the king ſeiz'd*, &c.
Thus long ago,
While organs yet were mute;
Timotheus, to his breathing flute,
And ſounding lyre,
Could ſwell the ſoul to rage, or kindle ſoft deſire.
At laſt divine Cecilia came,
Inventreſs of the vocal frame;
The ſweet enthuſiaſt, from her ſacred ſtore,
Enlarg'd the former narrow bounds,
And added length to ſolemn ſounds,
With nature's mother-wit, and arts unknown before.
Let old Timotheus yield the prize
Or both divide the crown;
He rais'd a mortal to the ſkies:
She drew an angel down.
Grand chor. *At laſt*, &c.

There is another poem by Dryden, on the death of Mrs Anne Killegrew, a young lady eminent for her ſkill in poetry and painting, which a great critic * has pronounced to be "undoubtedly the nobleſt ode that our language has ever produced. He owns, that as a whole it may perhaps be inferior to *Alexander's Feaſt*; but he affirms that the firſt ſtanza of it is ſuperior to any ſingle part of the other. This famous ſtanza, he ſays, flows with a torrent of enthuſiaſm. *Fervet immenſuſque ruit*. How far this criticiſm is juſt, the public muſt determine.

I

Thou youngeſt virgin-daughter of the ſkies,
Made in the laſt promotion of the bleſs'd;
Whoſe palms, new-pluck'd from Paradiſe,
In ſpreading branches more ſublimely riſe,
Rich with immortal green above the reſt;
Whether, adopted to ſome neighb'ring ſtar,
Thou roll'ſt above us, in thy wand'ring race,
Or in proceſſion fix'd and regular,
Mov'd with the heav'n's majeſtic pace;
Or, call'd to more ſuperior bliſs,
Thou tread'ſt with ſeraphims the vaſt abyſs:
Whatever happy region is thy place,
Ceaſe thy celeſtial ſong a little ſpace;
Thou wilt have time enough for hymns divine,
Since heaven's eternal year is thine.
Hear then a mortal muſe thy praiſe rehearſe
In no ignoble verſe;
But ſuch as thy own voice did practiſe here,
When thy firſt fruits of poeſy were giv'n
To make thyſelf a welcome inmate there;
While yet a young probationer,
And candidate of heav'n.

II.

If by traduction came thy mind,
Our wonder is the leſs to find
A ſoul ſo charming from a ſtock ſo good;
Thy father was transfus'd into thy blood,
So wert thou born into a tuneful ſtrain.
An early, rich, and inexhauſted vein.
But if thy pre-exiſting ſoul
Was form'd at firſt with myriads more,
It did through all the mighty poets roll,
Who Greek or Latin laurels wore,
And was that Sappho laſt which once it was before,
If ſo, then ceaſe thy flight, O heaven-born mind!
Thou haſt no droſs to purge from thy rich ore,
Nor can thy ſoul a fairer manſion find,
Than was the beauteous frame ſhe left behind:
Return to fill or mend the choir of thy celeſtial kind.

III.

May we preſume to ſay, that, at thy birth,
New joy was ſprung in heav'n, as well as here on earth?
For ſure the milder planets did combine
On thy auſpicious horoſcope to ſhine,
And e'en the moſt malicious were in trine.
Thy brother angels at thy birth
Strung each his lyre, and tun'd it high,
That all the people of the ſky
Might know a poeteſs was born on earth.
And then, if ever, mortal ears
Had heard the muſic of the ſpheres.
And if no cluſt'ring ſwarm of bees
On thy ſweet mouth diſtill'd their golden dew,
'Twas that ſuch vulgar miracles
Heav'n had not leiſure to renew:
For all thy bleſs'd fraternity of love
Solemniz'd there thy birth, and kept thy holy day above.

IV.

O gracious God! how far have we
Profan'd thy heav'nly gift of poeſy?
Made proſtitute and profligate the Muſe,
Debas'd to each obſcene and impious uſe,

---

* Dr Johnſon.

Whoſe harmony was firſt ordain'd above
For tongues of angels, and for hymns of love?
O wretched we! why were we hurry'd down
This lubrique and adult'rate age,
(Nay added fat pollutions of our own)
T'increaſe the ſtreaming ordures of the ſtage!
What can we ſay t'excuſe our ſecond fall?
Let this thy veſtal, Heav'n, atone for all:
Her Arethuſian ſtream remains unſoil'd,
Unmix'd with foreign filth, and undefil'd;
Her wit was more than man, her innocence a child.
V.
Art ſhe had none, yet wanted none;
For nature did that want ſupply:
So rich in treaſures of her own,
She might our boaſted ſtores defy:
Such noble vigour did her verſe adorn,
That it ſeem'd borrow'd where 'twas only born.
Her morals, too, were in her boſom bred,
By great examples daily fed.
What in the beſt of books, her father's life ſhe read.
And to be read herſelf, ſhe need not fear;
Each teſt, and every light, her Muſe will bear,
Tho' Epictetus with his lamp were there.
E'en love (for love ſometimes her Muſe expreſs'd)
Was but a lambent flame which play'd about her breaſt,
Light as the vapours of a morning dream,
So cold herſelf, while ſhe ſuch warmth expreſs'd,
'Twas Cupid bathing in Diana's ſtream.
VI.
Born to the ſpacious empire of the Nine,
One would have thought ſhe ſhould have been content
To manage well that mighty government;
But what can young ambitious ſouls confine?
To the next realm ſhe ſtretch'd her ſway,
For *Painture* near adjoining lay,
A plenteous province and alluring prey.
A *Chamber of Dependencies* was fram'd,
(As conquerors will never want pretence,
When arm'd, to juſtify th' offence)
And the whole fief, in right of poetry, ſhe claim'd.
The country open lay without defence:
For poets frequent inroads there had made,
And perfectly could repreſent
The ſhape, the face, with ev'ry lineament,
And all the large domains which the *dumb ſiſter* ſway'd.
All bow'd beneath her government,
Receiv'd in triumph whereſoe'er ſhe went.
Her pencil drew whate'er her ſoul deſign'd,
And oft the happy draught ſurpaſs'd the image in her mind.
The ſylvan ſcenes of herds and flocks,
And fruitful plains and barren rocks,
Of ſhallow brooks that flow'd ſo clear,
The bottom did the top appear;
Of deeper too, and ampler floods,
Which, as in mirrors, ſhow'd the woods:
Of lofty trees, with ſacred ſhades,
And perſpectives of pleaſant glades,
Where nymphs of brighteſt form appear,
And ſhaggy ſatyrs ſtanding near,
Which them at once admire and fear.
The ruins too of ſome majeſtic piece,
Boaſting the power of ancient Rome or Greece,
Whoſe ſtatues, freezes, columns, broken lie,
And, though defac'd, the wonder of the eye;
What nature, art, bold fiction, e'er durſt frame,
Her forming hand gave feature to the name.
So ſtrange a concourſe ne'er was ſeen before,
But when the peopled ark the whole creation bore.
VII.
The ſcene then chang'd, with bold erected look
Our martial king the ſight with rev'rence ſtruck;
For not content t'expreſs his outward part
Her hand call'd out the image of his heart:
His warlike mind, his ſoul devoid of fear,
His high-deſigning thoughts were figur'd there,
As when, by magic, ghoſts are made appear.
Our phœnix queen was pourtray'd too ſo bright,
Beauty alone could beauty take ſo right:
Her dreſs, her ſhape, her matchleſs grace,
Were all obſerv'd, as well as heav'nly face.
With ſuch a peerleſs majeſty ſhe ſtands,
As in that day ſhe took the crown from ſacred hands;
Before a train of heroines was ſeen,
In beauty foremoſt, as in rank, the queen.
Thus nothing to her genius was denied,
But like a ball of fire the further thrown,
Still with a greater blaze ſhe ſhone,
And her bright ſoul broke out on ev'ry ſide.
What next ſhe had deſign'd, Heav'n only knows:
To ſuch immod'rate growth her conqueſt roſe,
That fate alone its progreſs could oppoſe.
VIII.
Now all thoſe charms, that blooming grace,
The well proportion'd ſhape, and beauteous face,
Shall never more be ſeen by mortal eyes;
In earth the much lamented virgin lies.
Nor wit nor piety could fate prevent;
Nor was the cruel *Deſtiny* content
To finiſh all the murder at a blow,
To ſweep at once her life and beauty too;
But, like a harden'd felon, took a pride
To work more miſchievouſly ſlow,
And plunder'd firſt, and then deſtroy'd.
O double ſacrilege on things divine,
To rob the relick, and deface the ſhrine!
But thus Orinda died:
Heav'n, by the ſame diſeaſe, did both tranſlate;
As equal were their ſouls, ſo equal was their fate
IX.
Meantime her warlike brother on the ſeas
His waving ſtreamers to the winds diſplays,
And vows for his return, with vain devotion, pays.
Ah generous youth! that wiſh forbear
The winds too ſoon will waft thee here!
Slack all thy ſails, and fear to come,
Alas, thou know'ſt not, thou art wreck'd at home!
No more ſhalt thou behold thy ſiſter's face,
Thou haſt already had her laſt embrace.
But look aloft, and if thou kenn'ſt from far,
Among the Pleiads a new-kindled ſtar,
If any ſparkles than the reſt more bright,
'Tis ſhe that ſhines in that propitious light.
X.
When in mid-air the golden trump ſhall ſound,
To raiſe the nations under ground;
When in the valley of Jehoſhaphat,
The judging God ſhall cloſe the book of fate;
And there the laſt *aſſizes* keep
For thoſe who wake and thoſe who ſleep:

When rattling bones together fly
From the four corners of the ſky;
When ſinews o'er the ſkeletons are ſpread,
Thoſe cloth'd with fleſh, and life inſpires the dead;
The ſacred poets firſt ſhall hear the ſound,
And foremoſt from the tomb ſhall bound,
For they are cover'd with the lighteſt ground;
And ſtraight with in-born vigour, on the wing,
Like mounting larks to the new morning ſing.
There thou, ſweet ſaint, before the quire ſhall go,
As harbinger of heav'n, the way to ſhow,
The way which thou ſo well haſt learnt below.

That this is a fine ode, and not unworthy of the genius of Dryden, muſt be acknowledged; but that it is the nobleſt which the Engliſh language has produced, or that any part of it runs with the torrent of enthuſiaſm which characterizes *Alexander's Feaſt*, are poſitions which we feel not ourſelves inclined to admit. Had the critic by whom it is ſo highly praiſed, inſpected it with the eye which ſcanned the odes of Gray, we cannot help thinking that he would have perceived ſome parts of it to be tediouſly minute in deſcription, and others not very perſpicuous at the firſt peruſal. It may perhaps, upon the whole, rank as high as the following ode by Collins on the Popular Superſtitions of the Highlands of Scotland; but to a higher place it has ſurely no claim.

I.
Home, thou return'ſt from Thames, whoſe Naiads long
Have ſeen thee ling'ring with a fond delay,
Mid thoſe ſoft friends, whoſe hearts ſome future day,
Shall melt, perhaps to hear thy tragic ſong,
Go not unmindful of that cordial youth (G)
Whom, long endear'd, thou leav'ſt by Lavant's ſide;
Together let us wiſh him laſting truth,
And joy untainted with his deſtined bride.
Go! nor regardleſs, while theſe numbers boaſt
My ſhort-liv'd bliſs, forget my ſocial name;
But think, far off, how, on the ſouthern coaſt,
I met thy friendſhip with an equal flame!
Freſh to that ſoil thou turn'ſt, *where* * ev'ry vale — * whoſe
Shall prompt the poet, and his ſong demand:
To thee thy copious ſubjects ne'er ſhall fail;
Thou need'ſt but take thy pencil to thy hand,
And paint what all believe who own thy genial land.
II.
There muſt thou wake perforce thy Doric quill;
'Tis fancy's land to which thou ſett'ſt thy feet;
Where ſtill, 'tis ſaid, the Fairy people meet,
Beneath each birken ſhade, on mead or hill.
There, each trim laſs, that ſkims the milky ſtore,
To the ſwart, tribes their creamy bowl allots;
By night they ſip it round the cottage door,
While airy minſtrels warble jocund notes.
There, ev'ry herd, by ſad experience, knows,
How, wing'd with Fate, their elf-ſhot arrows fly,
When the ſick ewe her ſummer food forgoes,
Or, ſtretcht on earth, the heart-ſmit heifers lie.
Such airy beings awe th' untutor'd ſwain:
Nor thou, tho' learn'd, his homelier thoughts neglect:
Let thy ſweet Muſe the rural faith ſuſtain;
Theſe are the themes of ſimple, ſure effect,
That add new conqueſts to her boundleſs reign,
And fill, with double force, her heart-commanding ſtrain.
III.
Ev'n yet preſerv'd, how often may'ſt thou hear,
Where to the pole the Boreal mountains run,
Taught by the father to his liſt'ning ſon,
Strange lays, whoſe pow'r had charm'd a Spencer's ear.
At every pauſe, before thy mind poſſeſt,
Old Runic bards ſhall ſeem to riſe around,
With uncouth lyres in many-colour'd veſt,
Their matted hair with boughs fantaſtic crown'd:
Whether thou bid'ſt the well-taught hind repeat
The choral dirge that mourns ſome chieſtain brave,
When ev'ry ſhrieking maid her boſom beat,
And ſtrew'd with choiceſt herbs his ſcented grave;
Or whether ſitting in the ſhepherd's ſhiel (H),
Thou hear'ſt ſome ſounding tale of war's alarms,
When, at the bugle's call, with fire and ſteel,
The ſturdy clans pour'd forth their *brawny* ‡ ſwarms, — ‡ bony.
And hoſtile brothers met to prove each other's arms.
IV.
'Tis thine to ſing how framing hideous ſpells,
In Sky's lone iſle the gifted wizzard-*ſeer* §, — § ſits.
Lodg'd in the wintry cave with Fate's fell ſpear (I),
Or in the depth of Uiſt's dark foreſt dwells:
How they whoſe ſight ſuch dreary dreams engroſs,
With their own viſions oft aſtoniſh'd droop,
When, o'er the wat'ry ſtrath, or quaggy moſs,
They ſee the gliding ghoſts *unbodied* ‡ troop. — ‡ embodied.
Or, if in ſports, or on the feſtive green,
Their *deſtin'd* † glance ſome fated youth deſcry, — † piercing
Who now, perhaps, in luſty vigour ſeen,
And roſy health, ſhall ſoon lamented die.
For them the viewleſs forms of air obey;
Their bidding heed, and at their beck repair.
They know what ſpirit brews the ſtormful day,
And heartleſs, oft like moody madneſs, ſtare
To ſee the phantom train their ſecret work prepare.
V.
To monarchs dear (K), ſome hundred miles aſtray,
Oft have they ſeen Fate give the fatal blow!
The ſeer in Sky ſhriek'd as the blood did flow
When headleſs Charles warm on the ſcaffold lay!

(G) A gentleman of the name of *Barrow*, who introduced Home to Collins.

(H) A ſummer hut, built in the high part of the mountains, to tend their flocks in the warm ſeaſon, when the paſture is fine.

(I) Waiting in wintery cave his wayward fit.

(K) Of this beautiful ode two copies have been printed: one by Dr Carlyle, from a manuſcript which he acknowledges to be mutilated; another by an editor who ſeems to hope that a nameleſs ſomebody will be believed, when he declares, that "he diſcovered a *perfect copy* of this admirable ode among ſome old papers in the concealed drawers of a bureau left him by a relation." The preſent age has been already too much amuſed with pretended diſcoveries of poems in the bottoms of *old cheſts*, to pay full credit to an aſſertion of this kind, even though the

As boreas threw his young Aurora (L) forth,
In the firſt year of the firſt George's reign,
And battles rag'd in welkin of the North,
They mourn'd in air, fell, fell rebellion ſlain!
And as if late they joy'd in Preſton's fight,
Saw at ſad Falkirk all their hopes near crown'd!
They rav'd divining through their ſecond-ſight (M),
Pale, red Culloden, where theſe hopes were drown'd!
Illuſtrious William (N)! Britain's guardian name?
One William ſav'd us from a tyrant's ſtroke;
He, for a ſceptre, gain'd heroic fame,
But thou, more glorious, Slavery's chain haſt broke,
To reign a private man, and bow to Freedom's yoke!

VI.

Theſe, too, thou'lt ſing! for well thy magic muſe
Can to the topmoſt heav'n of grandeur ſoar!
Or ſtoop to wail the ſwain that is no more!
Ah, homely ſwains! your homeward ſteps ne'er loſe;
Let not dank *Will* (O) miſlead you to the heath:
Dancing in mirky night, o'er fen and lake,
He glows, to draw you downward to your death,
In his bewitch'd, low, marſhy, willow brake!
What though far off, from ſome dark dell eſpied,
His glim'ring mazes cheer th' excurſive ſight,
Yet turn, ye wand'rers, turn your ſteps aſide,
Nor truſt the guidance of that faithleſs light;
For watchful, lurking, 'mid th' unruſtling reed,
At thoſe mirk hours the wily monſter lies,
And liſtens oft to hear the paſſing ſteed.
And frequent round him rolls his ſullen eyes,
If chance his ſavage wrath may ſome weak wretch ſurpriſe.

VII.

Ah, luckleſs ſwain o'er all unbleſt, indeed!
Whom late bewilder'd in the dark, dark fen,
Far from his flocks, and ſmoking hamlet then!
To that ſad ſpot * *where hums the ſedgy weed.*

* his wayward fate ſhall lead.

On him, enrag'd, the fiend in angry mood,
Shall never look with pity's kind concern,
But inſtant, furious, raiſe the whelming flood,
O'er its drown'd banks, forbidding all return!
Or, if he meditate his wiſh'd eſcape,
To ſome dim hill that ſeems upriſing near,
To his faint eye, the grim and griſly ſhape,
In all its terrors clad, ſhall wild appear.
Meantime the wat'ry ſurge ſhall round him riſe,
Pour'd ſudden forth from ev'ry ſwelling ſource!
What now remains but tears and hopeleſs ſighs?
His fear-ſhook limbs have loſt their youthful force,
And down the waves he floats, a pale and breathleſs corſe!

VIII.

For him in vain his anxious wife ſhall wait,
Or wander forth to meet him on his way;
For him in vain, at to-fall of the day;
His babes ſhall linger at th' uncloſing gate!
Ah, ne'er ſhall he return! Alone, if night,
Her travell'd limbs in broken ſlumbers ſteep?
With drooping willows dreſt, his mournful ſprite
Shall viſit ſad, perchance, her ſilent ſleep:
Then he perhaps, with moiſt and wat'ry hand,
Shall fondly ſeem to preſs her ſhudd'ring cheek,
And with his blue-ſwoln face before her ſtand,
And, ſhiv'ring cold, theſe piteous accents ſpeak:
“ Purſue, dear wife, thy daily toils purſue,
“ At dawn or duſk, induſtrious as before;
“ Nor e'er of me one **helpleſs* thought renew,
“ While I lie welt'ring on the ozier'd ſhore,
“ Drown'd by the kelpie's† wrath, nor e'er ſhall aid thee more!”

* hapleſs

† the water fiend.

IX.

Unbounded is thy range; with varied *ſkill**
Thy muſe may, like thoſe feath'ry tribes which ſpring
From their rude rocks, extend her ſkirting wing
Round the moiſt marge of each cold Hebrid iſle,
To

* ſtyle,

---

the ſcene of diſcovery be laid in a *bureau*. As the ode of the anonymous editor differs, however, very little from that of Dr Carlyle, and as what is affirmed by a GENTLEMAN *may* be true, though “ he chooſes not at preſent to publiſh his name,” we have inſerted into our work the copy which pretends to be perfect, noting at the bottom or margin of the page the different readings of Dr Carlyle's edition. In the Doctor's manuſcript, which appeared to have been nothing more than the *prima cura*, or firſt ſketch of the poem, the fifth ſtanza and half of the ſixth were wanting; and to give a continued context, he prevailed with Mr M'Kenzie, the ingenious author of the *Man of Feeling*, to fill up the chaſm. This he did by the following beautiful lines, which we cannot help thinking much more happy than thoſe which occupy their place in the copy ſaid to be perfect:

“ Or on ſome bellying rock that ſhades the deep,
They view the lurid ſigns that croſs the ſky,
Where in the weſt the brooding tempeſts lie;
And hear their firſt, faint, ruſtling pennons ſweep.
Or in the arched cave, where deep and dark
The broad unbroken billows heave and ſwell,
In horrid muſings wrapt, they ſit to mark
The lab'ring moon; or liſt the nightly yell
Of that dread-ſpirit, whoſe gigantic form
The ſeer's entranced eye can well ſurvey,
Through the dim air who guides the driving ſtorm,
And points the wretched bark its deſtin'd prey.
Or him who hovers on his flagging wing,
O'er the dire whirlpool, that in ocean's waſte,
Draws inſtant down whate'er devoted thing
The falling breeze within its reach hath plac'd——
The diſtant ſeaman hears, and flies with trembling haſte.

Or if on land the fiend exerts his ſway,
Silent he broods o'er quickſand, bog, or fen,
Far from the ſhelt'ring roof and haunts of men,
When witched darkneſs ſhuts the eye of day,
And ſhrouds each ſtar that wont to cheer the night;
Or if the driſted ſnow perplex the way,
With treach'rous gleam he lures the fated wight;
And leads him flound'ring on and quite aſtray.”

(L) By young Aurora, Collins undoubtedly meant the firſt appearance of the northern lights, which is commonly ſaid to have happened about the year 1715,

(M) Second-ſight is the term that is uſed for the divination of the Highlanders.

(N) The late duke of Cumberland, who defeated the Pretender at the battle of Culloden.

(O) A fiery meteor, called by various names, ſuch as *Will with the Wiſp*, *Jack with the Lanthorn*, &c. It hovers in the air over marſhy and fenny places.

To that hoar pile (P) which ſtill its ruin ſhows:
In whoſe ſmall vaults, a pigmy-folk is found,
Whoſe bones the delver with his ſpade upthrows,
And culls them, wond'ring, from the hallow'd ground!
Or thither (Q), where beneath the ſhow'ry weſt,
The mighty kings of three fair realms are laid:
Once foes perhaps, together now they reſt,
No ſlaves revere them, and no wars invade:
Yet frequent now, at midnight ſolemn hour,
The rifted mounds their yawning cells unfold,
And forth the monarchs ſtalk with ſov'reign pow'r
In pageant robes; and, wreath'd with ſheeny gold,
And on their twilight tombs aerial council hold.

X.

But, oh! o'er all, forget not Kilda's race,
On whoſe bleak rocks, which brave the waſting tides,
Fair Nature's daughter, Virtue, yet abides.
Go! juſt, as they, their blameleſs manners trace!
Then to my ear tranſmit ſome gentle ſong,
Of thoſe whoſe lives are yet ſincere and plain,
Their bounded walks the rugged cliffs along,
And all their proſpect but the wintery main.
With ſparing temperance of the needful time,
They drain the ſcented ſpring; or, hunger-preſt,
Along th' Atlantic rock, undreading, climb,
And of its eggs deſpoil the Solan's neſt*.
Thus, bleſt in primal innocence, they live,
Suffic'd, and happy with that frugal fare
Which taſteful toil and hourly danger give.
Hard is their ſhallow ſoil, and bleak and bare;
Nor ever vernal bee was heard to murmur there!

* See Bird-catching. p 237, and Pelicanus, n° 3.

XI.

Nor need'ſt thou bluſh that ſuch falſe themes engage
Thy gentle mind, of fairer ſtores poſſeſt;
For not alone they touch the village breaſt,
But fill'd in elder time th' hiſtoric page.
There, Shakeſpeare's ſelf, with every garland crown'd,
Flew to thoſe Fairy climes his fancy ſheen (R),
In muſing hour; his wayward ſiſters found,
And with their terrors dreſs'd the magic ſcene.
From them he ſung, when, 'mid his bold deſign,
Before the Scot, afflicted, and aghaſt!
The ſhadowy kings of Banquo's fated line,
Thro' the dark cave in gleamy pageant paſs'd.
Proceed! nor quit the tales which, ſimply told,
Could once ſo well my anſw'ring boſom pierce;
Proceed, in forceful ſounds, and colours bold,
The native legends of thy land rehearſe;
To ſuch adapt the lyre, and ſuit thy pow'rful verſe.

XII.

In ſcenes like theſe, which, daring to depart
From ſober truth, are ſtill to nature true,
And call forth freſh delight to fancy's view,
Th' heroic muſe employ'd her Taſſo's art!
How have I trembl'd, when, at Tancred's ſtroke,
Its guſhing blood the gaping cypreſs pour'd,
When each live plant with mortal accents ſpoke,
And the wild blaſt upheav'd the vaniſh'd ſword!
How have I ſat, when pip'd the penſive wind,
To hear his harp by Britiſh Fairfax ſtrung!
Prevailing poet! whoſe undoubting mind,
Believ'd the magic wonders which he ſung!
Hence, at each ſound, imagination glows!
Hence, at each picture, vivid life ſtarts here! (S)
Hence his warm lay with ſofteſt ſweetneſs flows!
Melting it flows, pure, *murm'ring**, ſtrong, and clear,
And fills th' impaſſioned heart, and wins th' harmonious [ear!

* numerous.

XIII.

All hail, ye ſcenes that o'er my ſoul prevail!
Ye *ſplendid*† friths and lakes, which, far away,
Are by ſmooth Annan ‡ fill'd, or paſt'ral Tay ‡,
Or Don's‡ romantic ſprings, at diſtance, hail!
The time ſhall come, when I, perhaps, may tread
Your lowly *glens* §, o'erhung with ſpreading broom!
Or o'er your ſtretching heaths, by fancy led,
Or o'er your mountains creep, in awful gloom! (T)
Then will I dreſs once more the faded bow'r,
Where Jonſon (U) ſat in Drummond's *claſſic** ſhade;
Or crop, from Tiviotdale, each lyric flow'r,
And mourn, on Yarrow's banks, *where Willy's laid*†!
Meantime' ye pow'rs that on the plains which bore
The cordial youth, on Lothian's plains (X), attend!
Where'er HOME *dwells* ‡, on hill, or lowly moor,
To him I *looſe* §, your kind protection lend, [friend!
And, touch'd with love like mine, preſerve my abſent

† ſpacious.
‡ Three rivers in Scotland,
§ Valleys.
* ſocial,
† the widowed maid!
‡ he dwells
§ loſe,

Dr Johnſon, in his life of Collins, informs us, that Dr Warton and his brother, who had ſeen this ode in the author's poſſeſſion, thought it ſuperior to his other works. The taſte of the Wartons will hardly be queſtioned; but we are not ſure that the following *Ode to the Paſſions* has much leſs merit, though it be merit of a different kind, than the Ode on the Superſtitions of the Highlands:

WHEN Muſic, heav'nly maid was young,
While yet in early Greece ſhe ſung,
The Paſſions oft to hear her ſhell,
Throng'd around her magic cell,
Exulting, trembling, raging, fainting,
Poſſeſt beyond the Muſe's painting;
By turns they felt the glowing mind
Diſturb'd, delighted, rais'd, refin'd.
Till once, 'tis ſaid, when all were fir'd,
Fill'd with fury, rapt, inſpir'd,
From the ſupporting myrtles round
They ſnatch'd her inſtruments of ſound:
And as they oft had heard apart
Sweet leſſons of her forceful art,

Each,

(P) One of the Hebrides is called the *Iſle of Pigmies*, where it is reported, that ſeveral miniature bones of the human ſpecies have been dug up in the ruins of a chapel there.

(Q) Icolmkill, one of the Hebrides, where many of the ancient Scottiſh, Iriſh, and Norwegian kings, are ſaid to be interred.

(R) This line wanting in Dr Carlyle's edition.

(S) This line wanting in Dr Carlyle's edition.

(T) This line wanting in Dr Carlyle's edition.

(U) Ben Jonſon paid a viſit on foot in 1619 to the Scotch poet Drummond, at his ſeat of Hawthornden, within ſeven miles of Edinburgh.

(X) Barrow, it ſeems, was at the univerſity of Edinburgh, which is in the county of Lothian.

Each, for madneſs rul'd the hour,
Would prove his own expreſſive pow'r.

Firſt Fear his hand, its ſkill to try,
Amid the chords bewilder'd laid,
And back recoil'd, he knew not why,
Ev'n at the ſound himſelf had made.

Next Anger ruſh'd; his eyes on fire,
In lightnings own'd his ſecret ſtings;
In one rude claſh he ſtruck the lyre,
And ſwept with hurried hand the ſtrings.

With woeful meaſures wan Deſpair—
Low ſullen ſounds his grief beguil'd;
A ſolemn, ſtrange, and mingled air;
'Twas ſad by fits, by ſtarts 'twas wild.

But thou, O Hope! with eyes ſo fair,
What was thy delighted meaſure?
Still it whiſper'd promis'd pleaſure,
And bade the lovely ſcenes at diſtance hail!—
Still would her touch the ſtrain prolong,
And from the rocks, the woods, the vale,
She call'd on Echo ſtill through all her ſong;
And where her ſweeteſt theme ſhe choſe,
A ſoft reſponſive voice was heard at every cloſe,
And Hope enchanted ſmil'd, and wav'd her golden hair.

And longer had ſhe ſung;—but, with a frown,
Revenge impatient roſe;
He threw his blood-ſtain'd ſword in thunder down,
And, with a withering look,
The war-denouncing trumpet took,
And blew a blaſt ſo loud and dread,
Were ne'er prophetic ſounds ſo full of woe.
And ever and anon he beat
The doubling drum with furious heat;
And though ſometimes, each dreary pauſe between,
Dejected Pity at his ſide
Her ſoul-ſubduing voice applied,
Yet ſtill he kept his wild unalter'd mien,
While each ſtrain'd ball of ſight ſeem'd burſting from his head.

Thy numbers, Jealouſy, to nought were fix'd,
Sad proof of thy diſtreſsful ſtate;
Of differing themes the veering ſong was mix'd;
And now it courted Love, now raving call'd on Hate.

With eyes up-rais'd, as one inſpir'd,
Pale Melancholy ſat retir'd,
And from her wild ſequeſter'd ſeat,
In notes by diſtance made more ſweet,
Pour'd through the mellow horn her penſive ſoul,
And daſhing ſoft from rocks around,
Bubbling runnels join'd the ſound;
Through glades and glooms the mingled meaſure ſtole,
Or o'er ſome haunted ſtreams with fond delay,
Round an holy calm diffuſing,
Love of peace, and lonely muſing,
In hollow murmurs died away.

But O! how alter'd was its ſprightlier tone!
When cheerfulneſs, a nymph of healthieſt hue,
Her bow acroſs her ſhoulder flung,
Her buſkins gemm'd with morning dew,
Blew an inſpiring air, that dale and thicket rung,
The hunter's call to Faun and Dryad known;
The oak-crown'd ſiſters, and their chaſte-ey'd queen,
Satyrs and ſylvan boys were ſeen,
Peeping from forth their alleys green;
Brown Exerciſe rejoic'd to hear,
And Sport leapt up, and ſeiz'd his beechen ſpear.

Laſt came Joy's ecſtatic trial;
He, with viny crown advancing,
Firſt to the lively pipe his hand addreſt,
But ſoon he ſaw the briſk awakening viol,
Whoſe ſweet entrancing voice he lov'd the beſt.
They would have thought who heard the ſtrain,
They ſaw in Tempe's vale her native maids,
Amidſt the feſtal ſounding ſhades,
To ſome unwearied minſtrel dancing,
While, as his flying fingers kiſs'd the ſtrings,
Love fram'd with Mirth a gay fantaſtic round:
Looſe were her treſſes ſeen, her zone unbound
And he, amidſt his frolic play,
As if he would the charming air repay,
Shook thouſand odours from his dewy wings.

O Muſic! ſphere-deſcended maid,
Friend of pleaſure, wiſdom's aid,
Why, Goddeſs, why to us denied?
Lay'ſt thou thy ancient lyre aſide?
As in that lov'd Athenian bower,
You learn'd an all-commanding power:
Thy mimic ſoul, O Nymph endear'd,
Can well recal what then it heard.
Where is thy native ſimple heart,
Devote to virtue, fancy, art?
Ariſe, as in that elder time,
Warm energic, chaſte, ſublime!
Thy wonders, in that god-like age,
Fill thy recording ſiſter's page—
'Tis ſaid, and I believe the tale,
Thy humbleſt reed could more prevail,
Had more of ſtrength, diviner rage,
Than all which charms this laggard age;
Ev'n all at once together found
Cæcilia's mingled world of ſound—
O! bid our vain endeavours ceaſe,
Revive the juſt deſigns of Greece,
Return in all thy ſimple ſtate!
Confirm the tales her ſon's relate.

We ſhall conclude this ſection, and theſe examples, with Gray's *Progreſs of Poeſy*, which, in ſpite of the ſeverity of Johnſon's criticiſm, certainly ranks high among the odes which pretend to ſublimity. The firſt ſtanza when examined by the frigid rules of grammatical criticiſm, is certainly not faultleſs; but its faults will be overlooked by every reader who has any portion of the author's fervor:

I. 1.

Awake, Æolian lyre, awake,
And give to rapture all thy trembling ſtrings,
From Helicon's harmonious ſprings
A thouſand rills their mazy progreſs take:
The laughing flowers, that round them blow,
Drink life and fragrance as they flow.
Now the rich ſtream of muſic winds along,
Deep, majeſtic, ſmooth, and ſtrong,
Thro' verdant vales, and Ceres' golden reign:
Now rolling down the ſteep amain,
Headlong, impetuous, ſee it pour:
The rocks, and nodding groves, rebellow to the roar.

I. 2.
Oh! Sovereign of the willing ſoul,
Parent of ſweet and ſolemn-breathing airs,
Enchanting ſhell! the ſullen cares,
And frantic paſſions, hear thy ſoft controul,
On Thracia's hills the lord of war
Has curb'd the fury of his car,
And dropp'd his thirſty lance at thy command.
Perching on the ſceptred hand
Of Jove, thy magic lulls the feather'd king
With ruffled plumes, and flagging wing:
Quench'd in dark clouds of ſlumber lie
The terror of his beak, and lightnings of his eye.

I. 3.
Thee the voice, the dance, obey,
Temper'd to thy warbled lay:
O'er Idalias velvet-green
The roſy-crowned loves are ſeen.
On Cytherea's day,
With antic ſports, and blue-ey'd pleaſures,
Friſking light in frolic meaſures;
Now purſuing, now retreating,
Now in circling troops they meet;
To briſk notes, in cadence beating,
Glance their many-twinkling feet.
Slow melting ſtrains their queen's approach declare:
Where'er ſhe turns, the graces homage pay.
With arms ſublime, that float upon the air,
In gliding ſtate ſhe wins her eaſy way:
O'er her warm cheek, and riſing boſom, move
The bloom of young deſire, and purple light of love

II. 1.
Man's feeble race what ills await;
Labour, and penury, the racks of pain,
Diſeaſe, and ſorrow's weeping train,
And death, ſad refuge from the ſtorms of fate!
The fond complaint, my ſong, diſprove,
And juſtify the laws of Love.
Say, has he giv'n in vain the heav'nly muse?
Night, and all her ſickly dews,
Her ſpectres wan, and birds of boding cry,
He gives to range the dreary ſky;
Till down the eaſtern cliffs afar
Hyperion's march they ſpy, and glitt'ring ſhafts of war.

II. 2.
In climes beyond the ſolar road,
Where ſhaggy forms o'er ice-built mountains roam,
The Muſe has broke the twilight-gloom,
To cheer the ſhiv'ring native's dull abode.
And oft, beneath the od'rous ſhade
Of Chili's boundleſs foreſts laid,
She deigns to hear the ſavage youth repeat,
In looſe numbers wildly ſweet,
Their feather-cinctur'd chiefs, and duſky loves.
Her tract, where'er the goddeſs roves,
Glory purſue, and gen'rous ſhame,
Th' unconquerable mind, and freedom's holy flame.

II. 3.
Woods that wave o'er Delphi's ſteep,
Iſles, that crown th' Ægean deep,
Fields, that cool Iliſſus laves,
Or where Mæander's amber waves
In ling'ring lab'rinths creep,
How do your tuneful echoes languiſh
Mute, but to the voice of anguiſh!
Where each old poetic mountain
Inſpiration breath'd around;
Ev'ry ſhade and hallow'd fountain
Murmur'd deep a ſolemn ſound:
Till the ſad nine, in Greece's evil hour,
Left their Parnaſſus for the Latian plains,
Alike they ſcorn the pomp of tyrant power,
And coward vice that revels in her chains.
When Latium had her lofty ſpirit loſt,
They ſought, oh Albion! next thy ſea encircled coaſt.

III. 1.
Far from the ſun, and ſummer-gale,
In thy green lap was nature's * darling laid,
What time, where lucid Avon ſtray'd,
To him the mighty mother did unveil
Her awful face: the dauntleſs child
Stretch'd forth his little arms, and ſmil'd.
This pencil take (ſhe ſaid) whoſe colours clear
Richly paint the vernal year:
Thine too theſe golden keys, immortal boy!
This can unlock the gates of joy;
Of horror that, and thrilling fears,
Or ope the ſacred ſource of ſympathetic tears.

III. 2.
Nor ſecond he †, that rode ſublime
Upon the ſeraph-wings of ecſtaſy,
The ſecrets of th' abyſs to ſpy.
He paſs'd the flaming bounds of place and time:
The living throne, the ſapphire blaze,
Where angels tremble while they gaze,
He ſaw; but blaſted with exceſs of light,
Clos'd his eyes in endleſs night.
Behold, where Dryden's leſs preſumptuous car,
Wide o'er the fields of glory bear
Two courſers of ethereal race,
With necks in thunder cloth'd, and long reſounding pace.

III. 3.
Hark, his hands the lyre explore!
Bright-ey'd fancy, hov'ring o'er,
Scatters from her pictur'd urn
Thoughts that breathe, and words that burn.
But ah! 'tis heard no more—
Oh! Lyre divine, what daring ſpirit
Wakes thee now? tho' he inherit
Nor the pride, nor ample pinion,
That the Theban eagle bear,
Sailing with ſupreme dominion
Through the azure deep of air:
Yet oft before his infant eyes would run
Such forms as glitter in the Muſe's ray,
With orient hues, unborrow'd of the ſun:
Yet ſhall he mount, and keep his diſtant way
Beyond the limits of a vulgar fate,
Beneath the good how far—but far above the great.

SECT. III. *Of the Elegy.*

123 The elegy.

THE *Elegy* is a *mournful* and *plaintive*, but yet ſweet and engaging, kind of poem. It was firſt invented to bewail the death of a friend; and afterwards uſed to expreſs the complaints of lovers, or any other melancholy ſubject. In proceſs of time, not only matters of grief, but joy, wiſhes, prayers, expoſtulations, reproaches, admonitions, and almoſt every other ſubject, were admitted into elegy; however, funeral lamentations and affairs of love ſeem moſt agreeable to its character, which is gentleneſs and tenuity.

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* Shakeſpeare.

† Milton.

The plaintive elegy, in mournful ſtate,
Diſhevell'd weeps the ſtern decrees of fate:
Now paints the lover's torments and delights;
Now the nymph flatters, threatens, or invites.
But he, who would theſe paſſions well expreſs.
Muſt more of love than poetry poſſeſs,
I hate thoſe lifeleſs writers whoſe forc'd fire
In a cold ſtyle deſcribes a hot deſire;
Who ſigh by rule, and, raging in cold blood.
Their ſluggiſh muſe ſpur to an am'rous mood.
Their ecſtaſies inſipidly they feign;
And always pine, and fondly hug their chain;
Adore their priſon, and their ſuff'rings bleſs;
Make ſenſe and reaſon quarrel as they pleaſe.
'Twas not of old in this affected tone,
That ſmooth Tibullus made his am'rous moan;
Or tender Ovid, in melodious ſtrains,
Of love's dear art the pleaſing rules explains.
You, who in elegy would juſtly write,
Conſult your heart; let that alone endite:
[*From the French of* Deſpreux.] SOAMES.

134 How to be made. The plan of an elegy, as indeed of all other poems, ought to be made before a line is written; or elſe the author will ramble in the dark, and, his verſes have no dependance on each other, No *epigrammatic points* or conceits, none of thoſe *fine things* which moſt people are ſo fond of in every ſort of poem, can be allowed in this, but muſt give place to nobler beauties, thoſe of *nature* and the *paſſions*. Elegy rejects whatever is facetious, ſatirical, or majeſtic, and is content to be plain, decent, and unaffected; yet in this humble ſtate is ſhe ſweet and engaging, elegant and attractive. This poem is adorned with frequent *commiſerations*, *complaints exclamations*, *addreſſes*, *to things*, *or perſons*, ſhort and proper *digreſſions*, *alluſions*, *compariſons*, *proſopopœias* or feigned perſons, and ſometimes with ſhort *deſcriptions*. The diction ought to be free from any *harſhneſs*; *neat*, *eaſy*, *perſpicuous*, *expreſſive of the manners*, *tender*, and *pathetic*; and the numbers ſhould be *ſmooth* and *flowing*, and captivate the ear with their uniform ſweetneſs and delicacy.

Of elegies on the ſubject of death, that by Mr Gray, written in a country church-yard, is one of the beſt that has appeared in our language, and may be juſtly eſteemed a maſter-piece. But being ſo generally known, it would be ſuperfluous to inſert it here.

On the ſubject of love, we ſhall give an example from the elegies of Mr Hammond.

Let others boaſt their heaps of ſhining gold,
And view their fields with waving plenty crown'd,
Whom neighb'ring foes in conſtant terror hold,
And trumpets break their ſlumbers, never ſound:
While, calmly poor, I trifle life away,
Enjoy ſweet leiſure by my cheerful fire,
No wanton hope my quiet ſhall betray,
But cheaply bleſs'd I'll ſcorn each vain deſire.
With timely care Ill ſow my little field,
And plant my orchard with its maſter's hand;
Nor bluſh to ſpread the hay, the hook to wield,
Or range my ſheaves along the ſunny land.
If late at duſk, while careleſsly I roam,
I meet a ſtrolling kid or bleating lamb,
Under my arm I'll bring the wand'rer home,
And not a little chide its thoughtleſs dam.
What joy to hear the tempeſt howl in vain,
And claſp a fearful miſtreſs to my breaſt?
Or lull'd to ſlumber by the beating rain,
Secure and happy ſink at laſt to reſt.
Or if the ſun in flaming Leo ride,
By ſhady rivers indolently ſtray,
And, with my DELIA walking ſide by ſide,
Hear how they murmur, as they glide away.
What joy to wind along the cool retreat,
To ſtop and gaze on DELIA as I go!
To mingle ſweet diſcourſe with kiſſes ſweet,
And teach my lovely ſcholar all I know!
Thus pleas'd at heart, and not with fancy's dream,
In ſilent happineſs I reſt unknown;
Content with what I am, not what I ſeem
I live for DELIA and myſelf alone.
Ah fooliſh man! who, thus of her poſſeſs'd,
Could float and wander with ambition's wind,
And, if his outward trappings ſpoke him bleſt,
Not heed the ſickneſs of his conſcious mind.
With her I ſcorn the idle breath of praiſe,
Nor truſt to happineſs that's not our own;
The ſmile of fortune might ſuſpicion raiſe,
But here I know that I am lov'd alone.
STANHOPE, in wiſdom as in wit divine,
May riſe and plead Britannia's glorious cauſe,
With ſteady rein his eager wit confine,
While manly ſenſe the deep attention draws.
Let STANHOPE ſpeak his liſt'ning country's wrong,
My humble voice ſhall pleaſe one partial maid;
For her alone I pen my tender ſong,
Securely ſitting in his friendly ſhade.
STANHOPE ſhall come, and grace his rural friend;
DELIA ſhall wonder at her noble gueſt,
With bluſhing awe the riper fruit commend,
And for her huſband's patron cull the beſt.
Her's be the care of all my little train,
While I with tender indolence am bleſt,
The favourite ſubject of her gentle reign,
By love alone diſtinguiſh'd from the reſt.
For her I'll yoke my oxen to the plough,
In gloomy foreſts tend my lonely flock,
For her a goat-herd climb the mountain's brow,
And ſleep extended on the naked rock.
Ah! what avails to preſs the ſtately bed,
And far from her midſt taſteleſs grandeur weep,
By marble fountains lay the penſive head,
And, while they murmur, ſtrive in vain to ſleep!
DELIA alone can pleaſe and never tire,
Exceed the paint of thought in true delight;
With her, enjoyment wakens new deſire,
And equal rapture glows thro' ev'ry night.
Beauty and worth in her alike contend
To charm the fancy, and to fix the mind;
In her, my wife, my miſtreſs, and my friend,
I taſte the joys of ſenſe and reaſon join'd.
On her I'll gaze when others' loves are o'er,
And dying preſs her with my clay-cold hand——
Thou weep'ſt already, as I were no more,
Nor can that gentle breaſt the thought withſtand,
Oh! when I die, my lateſt moments ſpare,
Nor let thy grief with ſharper torments kill:
Wound not thy cheeks, nor hurt that flowing hair;
Tho' I am dead, my ſoul ſhall love the ſtill.

Oh quit the room, oh quit the deathful bed,
Or thou wilt die, ſo tender is thy heart!
Oh leave me, Delia! ere thou ſee me dead,
Theſe weeping friends will do thy mournful part.
Let them, extended on the decent bier,
Convey the corſe in melancholy ſtate,
Thro' all the village ſpread the tender tear,
While pitying maids our wond'rous love relate.

Sect. IV. *Of the Paſtoral.*

This poem takes its name from the Latin word *paſtor*, a "ſhepherd;" the ſubject of it being ſomething in the paſtoral or rural life; and the perſons, interlocutors, introduced in it, either ſhepherds or other ruſtics.

135 The paſtoral, These poems are frequently called *eclogues*, which ſignifies "ſelect or choice pieces;" though ſome account for this name in a different manner. They are alſo called *bucolicks*, from Βȣκολος, "a herdſman."

136 Why it generally pleaſes. This kind of poem, when happily executed, gives great delight; nor is it a wonder, ſince innocence and ſimplicity generally pleaſe: to which let us add, that the ſcenes of paſtorals are uſually laid in the country, where both poet and painter have abundant matter for the exerciſe of genius, ſuch as enchanting proſpects, purling ſtreams, ſhady groves, enamelled meads, flowery lawns, rural amuſements, the bleating of flocks, and the muſic of birds; which is of all melody the moſt ſweet and pleaſing, and calls to our mind the wiſdom and taſte of Alexander, who, on being importuned to hear a man that imitated the notes of the nightingale, and was thought a great curioſity, replied, that *he had had the happineſs of hearing the nightingale herſelf.*

137 Its characters and The character of the paſtoral conſiſts in ſimplicity, brevity, and delicacy; the two firſt render an eclogue *natural*, and the laſt *delightful.* With reſpect to nature, indeed, we are to conſider, that as a paſtoral is an image of the ancient times of innocence and undeſigning plainneſs, we are not to deſcribe ſhepherds as they really are at this day, but as they may be conceived then to have been, when the beſt of men, and even princes, followed the employment. For this reaſon an air of piety ſhould run through the whole poem; which is viſible in the writings of antiquity.

To make it natural with reſpect to the preſent age, ſome knowledge in rural affairs ſhould be diſcovered, and that in ſuch a manner, as if it was done by chance rather than by deſign; leſt, by too much pains to ſeem natural, that ſimplicity be deſtroyed from whence ariſes the delight; for what is ſo engaging in this kind of poeſy proceeds not ſo much from the idea of a country life itſelf, as in expoſing only the beſt part of a ſhepherd's life and concealing the misfortunes and miſeries which ſometimes attend it. Beſides, the ſubject muſt contain ſome particular beauty in itſelf, and each eclogue preſent a ſcene or proſpect to our view enriched with variety: which variety is in a great meaſure obtained by frequent compariſons drawn from the moſt agreeable objects of the country; by interrogations to things inanimate; by ſhort and beautiful digreſſions; and by elegant turns on the words, which render the numbers more ſweet and pleaſing. To this let us add, that the connections muſt be negligent, the narrations and deſcriptions ſhort, and the periods conciſe. Riddles, parables, proverbs, antique phraſes, and ſuperſtitious fables, are fit materials to be intermixed with this kind of poem. They are here, when properly applied, very ornamental; and the more ſo, as they give our modern compoſitions the air of the ancient manner of writing.

138 Style. The ſtyle of the paſtoral ought to be humble, yet pure; neat, but not florid; eaſy, and yet lively: and the numbers ſhould be ſmooth and flowing.

This poem in general ſhould be ſhort, and ought never much to exceed 100 lines; for we are to conſider that the ancients made this ſort of compoſitions their amuſement, and not their buſineſs: but however ſhort they are, every eclogue muſt contain a plot or fable, which muſt be ſimple and one; but yet ſo managed as to admit of ſhort digreſſions. Virgil has always obſerved this.—We ſhall give the plot or argument of his firſt paſtoral as an example. Melibœus, *an unfortunate ſhepherd, is introduced with* Tityrus, *one in more fortunate circumſtances; the former addreſſes the complaint of his ſufferings and baniſhment to the latter, who enjoys his flocks and folds in the midſt of the public calamity, and therefore expreſſes his gratitude to the benefactor from whom this favour flowed: but* Melibœus *accuſes fortune, civil wars, and bids adieu to his native country.* This is therefore a dialogue.

But we are to obſerve, that the poet is not always obliged to make his eclogue *allegorical*, and to have real perſons repreſented by the fictitious characters introduced; but is in this reſpect entirely at his own liberty.

Nor does the nature of the poem require it to be always carried on by way of dialogue; for a ſhepherd may with propriety ſing the praiſes of his love, complain of her inconſtancy, lament her abſence, her death, &c. and addreſs himſelf to groves, hills, rivers, and ſuch like rural objects, even when alone.

We ſhall now give an example from each of thoſe authors who have eminently diſtinguiſhed themſelves by this manner of writing, and introduce them in the order of time in which they were written.

139 Examples of the paſtoral from Theocritus. Theocritus, who was the father or inventor of this kind of poetry, has been deſervedly eſteemed by the beſt critics; and by ſome, whoſe judgment we cannot diſpute, preferred to all other paſtoral writers, with perhaps the ſingle exception of the tender and delicate Geſner. We ſhall inſert his third *idillyum*, not becauſe it is the beſt, but becauſe it is within our compaſs.

To Amaryllis, lovely nymph, I ſpeed,
Meanwhile my goats upon the mountains feed,
O Tityrus tend them with aſſiduous care,
Lead them to cryſtal ſprings and paſtures fair,
And of the ridgling's buttings horns beware.
Sweet Amaryllis, have you then forgot
Our ſecret pleaſures in the conſcious grott,
Where in my folding arms you lay reclin'd?
Bleſt was the ſhepherd, for the nymph was kind,
I whom you call'd *your Dear, your Love,* ſo late,
Say, am I now the object of your hate?
Say, is my form diſpleaſing to your ſight?
This cruel love will ſurely kill me quite.
Lo! ten large apples tempting to the view,
Pluck'd from your favourite tree, where late they grew.
Accept this boon, 'tis all my preſent ſtore;
To-morrow will produce as many more.

Paſtoral.

Meanwhile theſe heart-conſuming pains remove,
And give me gentle pity for my love.
Oh! was I made by ſome transforming power
A bee to buzz in your ſequeſter'd bow'r!
To pierce your ivy ſhade with murmuring ſound,
And the light leaves that compaſs you around.
I know thee, Love, and to my ſorrow find,
A god thou art, but of the ſavage kind;
A lioneſs ſure ſuckled the fell child,
And with his brothers nurſt him in the wild;
On me his ſcorching flames inceſſant prey,
Glow in my bones, and melt my ſoul away.
Ah, nymph, whoſe eyes deſtructive glances dart,
Fair is your face, but flinty is your heart:
With kiſſes kind this rage of love appeaſe;
For me, fond ſwain! ev'n empty kiſſes pleaſe,
Your ſcorn diſtracts me, and will make me tear
The flow'ry crown I wove for you to wear,
Where roſes mingle with the ivy-wreath,
And fragrant herbs ambroſial odours breathe.
Ah me! what pangs I feel; and yet the fair
Nor ſees my ſorrows nor will hear my pray'r.
I'll doff my garment, ſince I needs muſt die,
And from yon rock that points its ſummit high,
Where patient Alpis ſnares, the finny fry,
I'll leap, and, though perchance I riſe again,
You'll laugh to ſee me plunging in the main.
By a prophetic poppy-leaf I found
Your chang'd affection, for it gave no ſound,
Though in my hand ſtruck hollow as it lay,
But quickly wither'd like your love away.
An old witch brought ſad tidings to my ears,
She who tells fortunes with the ſieve and ſheers;
For leaſing barley in my field of late,
She told me, I ſhould love, and you ſhould hate!
For you my care a milk-white goat ſupply'd,
Two wanton kids run friſking at her ſide;
Which oft the nut-brown maid, Erithacis,
Has begg'd and paid before-hand with a kiſs;
And ſince you thus my ardent paſſion ſlight,
Her's they ſhall be before to-morrow night.
My right eye itches; may it lucky prove,
Perhaps I ſoon ſhall ſee the nymph I love;
Beneath yon pine I'll ſing diſtinct and clear,
Perhaps the fair my tender notes ſhall hear;
Perhaps may pity my melodious moan;
She is not metamorphos'd into ſtone.
  Hippomenes, provok'd by noble ſtrife,
To win a miſtreſs or to loſe his life,
Threw golden fruit in Atalanta's way:
The bright temptation caus'd the nymph to ſtay;
She look'd, ſhe languiſh'd, all her ſoul took fire,
She plung'd into the gulph of deep deſire.
  To Pyle from Othrys ſage Melampus came,
He drove the lowing herd, yet won the dame;
Fair Pero bleſt his brother Bias' arms,
And in a virtuous race diffus'd unfading charms.
  Adonis fed his cattle on the plain,
And ſea-born Venus lov'd the rural ſwain;
She mourn'd him wounded in the fatal chace,
Nor dead diſmiſs'd him from her warm embrace.
Though young Endymion was by Cynthia bleſt,
I envy nothing but his laſting reſt.
Jaſion ſlumb'ring on the Cretan plain
Ceres once ſaw, and bleſt the happy ſwain
With pleaſures too divine for ears profane.

Paſtoral.

My head grows giddy, love affects me ſore;
Yet you regard not; ſo I'll ſing no more——
Here will I put a period to my care—
Adieu, falſe nymph, adieu ungrateful fair;
Stretch'd near the grotto, when I've breath'd my laſt,
My corſe will give the wolves a rich repaſt,
As ſweet to them as honey to your taſte.

FAWKES.

Virgil ſucceeds Theocritus, from whom he has in ſome places copied, and always imitated with ſucceſs. As a ſpecimen of his manner, we ſhall introduce his firſt paſtoral, which is generally allowed to be the moſt perfect.

MELIBOEUS and TITYRUS.

140 Virgil.

Mel. Beneath the ſhade which beechen boughs diffuſe,
You, Tityrus, entertain your ſylvan muſe.
Round the wide world in baniſhment we roam,
Forc'd from our pleaſing fields and native home;
While ſtretch'd at eaſe you ſing your happy loves,
And Amaryllis fills the ſhady groves.
  Tit. Theſe bleſſings friend, a deity beſtow'd;
For never can I deem him leſs than god.
The tender firſtlings of my woolly breed
Shall on his holy altar often bleed.
He gave me kine to graze the flow'ry plain,
And ſo my pipe renew'd the rural ſtrain.
  Mel. I envy not your fortune; but admire,
That while the raging ſword and waſteful fire
Deſtroy the wretched neighbourhood around,
No hoſtile arms approach your happy ground.
Far diff'rent is my fate; my feeble goats
With pains I drive from their forſaken cotes:
And this you ſee I ſcarcely drag along,
Who yeaning on the rocks has left her young,
The hope and promiſe of my falling fold,
My loſs by dire portents the gods foretold;
For, had I not been blind, I might have ſeen
Yon riven oak, the faireſt on the green,
And the hoarſe raven on the blaſted bough.
By croaking from the left preſag'd the coming blow.
But tell me, Tityrus, what heavenly pow'r
Preſerv'd your fortunes in that fatal hour?
  Tit. Fool that I was, I thought imperial Rome
Like Mantua, where on market-days we come,
And thither drive our tender lambs from home.
So kids and whelps their ſires and dams expreſs;
And ſo the great I meaſur'd by the leſs:
But country-towns, compar'd with her, appear
Like ſhrubs when lofty cypreſſes are near.
  Mel. What great occaſion call'd you hence to Rome?
  Tit. Freedom, which came at length, tho' ſlow to come:
Nor did my ſearch of liberty begin
Till my black hairs were chang'd upon my chin;
Nor Amaryllis would vouchſafe a look,
Till Galatea's meaner bonds I broke.
Till then a helpleſs, hopeleſs, homely ſwain,
I ſought not freedom, nor aſpir'd to gain:
Tho' many a victim from my folds was bought,
And many a cheeſe to country markets brought,
Yet all the little that I got I ſpent,
And ſtill return'd as empty as I went.
  Mel. We ſtood amaz'd to ſee your miſtreſs mourn,
Unknowing that ſhe pin'd for your return;
We wonder'd why ſhe kept her fruit ſo long,
For whom ſo late th' ungather'd apples hung;

But now the wonder ceaſes, ſince I ſee
She kept them only, Tityrus, for thee:
For thee the bubbling ſprings appear'd to mourn,
And whiſp'ring pines made vows for thy return.
Tit. What ſhould I do? while here I was enchain'd,
No glimpſe of godlike liberty remain'd;
Nor could I hope in any place but there
To find a god ſo preſent to my pray'r.
There firſt the youth of heav'nly birth I view'd,
For whom our monthly victims are renew'd.
He heard my vows, and graciouſly decreed
My grounds to be reſtor'd my former flocks to feed.
Mel. O fortunate old man! whoſefarm remains
For you ſufficient, and requites your pains,
Though ruſhes overſpread the neighb'ring plains,
Tho' here the marſhy grounds approach your fields,
And there the ſoil a ſtony harveſt yields.
Your teeming ewes ſhall no ſtrange meadows try,
Nor fear a rot from tainted company.
Behold yon bord'ring fence of ſallow trees. [bees:
Is fraught with flow'rs, the flow'rs are fraught with
The buſy bees, with a ſoft murm'ring ſtrain,
Invite to gentle ſleep, the lab'ring ſwain:
While from the neighb'ring rock with rural ſongs
The pruner's voice the pleaſing dream prolongs;
Stock-doves and turtles tell their am'rous pain,
And, from the lofty elms of love complain.
Tit. Th' inhabitants of ſeas and ſkies ſhall change,
And fiſh on ſhore and ſtags in air ſhall range,
The baniſh'd Parthian dwell on Arar's brink,
And the blue German ſhall the Tigris drink;
Ere I, forſaking gratitude and truth,
Forget the figure of that godlike youth.
Mel. But we muſt beg our bread in climes unknown,
Beneath the ſcorching or the freezing zone;
And ſome to fair Oaxis ſhall be ſold,
Or try the Libyan heat or Scythian cold;
The reſt among the Britons be confin'd,
A race of men from all the world disjoin'd.
O! muſt the wretched exiles ever mourn?
Nor after length of rolling years return?
Are we condemn'd by Fate's unjuſt decree,
No more our houſes and our homes to ſee?
Or ſhall we mount again the rural throne,
And rule the country, kingdoms once our own
Did we for theſe barbarians plant and ſow,
On theſe, on theſe our happy fields beſtow?
Good heav'n what dire effects from civil diſcord flow?
Now let me graft my pears, and prune the vine;
The fruit is theirs, the labour only mine.
Farewell my paſtures, my paternal ſtock!
My fruitful fields, and my more fruitful flock!
No more, my goats, ſhall I behold you climb
The ſteepy cliffs, or crop the flow'ry thyme;
No more extended in the grot below,
Shall ſee you browzing on the mountain's brow
The prickly ſhrubs, and after on the bare
Lean down the deep abyſs and hang in air!
No more my ſheep ſhall ſip the morning dew;
No more my ſong ſhall pleaſe the rural crew:
Adieu, my tuneful pipe! and all the world, adieu!
Tit. This night, at leaſt, with me forget your care;
Cheſnuts and curds and cream ſhall be your fare:
The carpet-ground ſhall be with leaves o'er-ſpread,
And boughs ſhall weave a cov'ring for your head:
For ſee yon ſunny hill the ſhade extends,
And curling ſmoke from cottages aſcends.

DRYDEN.

Spencer was the firſt of his countrymen who acquired any conſiderable reputation by this method of writing. We ſhall inſert his ſixth eclogue, or that for June, which is allegorical, as will be ſeen by the

ARGUMENT, "Hobbinol, from a deſcription of the pleaſures of the place, excites Colin to the enjoyment of them. Colin declares himſelf incapable of delight, by reaſon of his ill ſucceſs in love, and his loſs of Roſalind, who had treacherouſly forſaken him for Menalcas another ſhepherd. By Tityrus (mentioned before in Spencer's ſecond eclogue, and again in the twelfth) is plainly meant Chaucer, whom the author ſometimes profeſſed to imitate. In the perſon of Colin is repreſented the author himſelf; and Hobbinol's inviting him to leave the hill country, ſeems to allude to his leaving the North, where, as is mentioned in his life, he had for ſome time reſided."

141 Spencer.

Hob. Lo! Colin, here the place whoſe pleaſant ſight
From other ſhades hath wean'd my wand'ring mind:
Tell me, what wants me here, to work delight?
The ſimple air the gentle warbling wind,
So calm, ſo cool, as nowhere elſe I find:
The graſſy ground with dainty daiſies dight,
The bramble-buſh, where birds of every kind
To th' water's fall their tunes attemper right.
Col. O! happy Hobbinol, I bleſs thy ſtate,
That paradiſe haſt found which Adam loſt.
Here wander may thy flock early or late,
Withouten dread of wolves to been ytoſt;
Thy lovely lays here mayſt thou freely boaſt:
But I, unhappy man! whom cruel fate,
And angry gods, purſue from coaſt to coaſt,
Can nowhere find to ſhroud my luckleſs pate.
Hob. Then if by me thou liſt adviſed be,
Forſake the ſoil that ſo doth thee bewitch:
Leave me thoſe hills, where harbroughnis to ſee,
Nor holly-buſh, nor brere, nor winding ditch;
And to the dales reſort, where ſhepherds rich,
And fruitful flocks been everywhere to ſee:
Here no night-ravens lodge, more black than pitch,
Nor elviſh ghoſts, nor ghaſtly owls do flee.
But friendly fairies met with many graces,
And light-foot nymphs can chace the ling'ring night,
With heydeguies, and timely trodden traces;
While ſiſters nine, which dwell on Parnaſs height,
Do make them muſic, for their more delight;
And Pan himſelf to kiſs their cryſtal faces.
Will pipe and dance, when Phœbe ſhineth bright:
Such peerleſs pleaſures have we in theſe places.
Col. And I whilſt youth, and courſe of careleſs years,
Did let me walk withouten links of love,
In ſuch delights did joy amongſt my peers:
But riper age ſuch pleaſures doth reprove,
My fancy eke from former follies move
To ſtrayed ſteps: for time in paſſing wears
(As garments doen, which waxen old above)
And draweth new delights with hoary hairs.
Though couth I ſing of love, and tune my pipe
Unto my plantive pleas in verſes made:
Though would I ſeek for queen-apples unripe
To give my Roſalind, and in ſommer ſhade

Dight gawdy girlonds was my common trade,
To crown her golden locks: but years more ripe,
And loſs of her, whoſe love as liſe I wayde,
Thoſe weary wanton toys away did wipe.
Hob. Colin, to hear thy rhymes and roundelays,
Which thou wert wont on waſteful hills to ſing,
I more delight, than lark in ſommer days:
Whoſe echo made the neighbour groves to ring,
And taught the birds, which in the lower ſpring
Did ſhroud in ſhady leaves from ſunny rays,
Frame to thy ſong their cheerful cheriping,
Or hold their peace, for ſhame of thy ſweet lays.
I ſaw Calliope with muſes moe,
Soon as thy oaten pipe began to ſound,
Their ivory lutes and tamburins forego,
And from the fountain, where they ſate around,
Ren after haſtily thy ſilver ſound.
But when they came, where thou thy ſkill didſt ſhow,
They drew aback, as half with ſhame confound,
Shepherd to ſee, them in their art out-go.
Col. Of muſes, Hobbinol, I con no ſkill,
For they been daughters of the higheſt Jove,
And holden ſcorn of homely ſhepherds quill:
For ſith I heard that Pan with Phœbus ſtrove
Which him to much rebuke and danger drove,
I never liſt preſume to Parnaſs' hill,
But piping low, in ſhade of lowly grove,
I play to pleaſe myſelf, albeit ill.
Nought weigh I, who my ſong doth praiſe or blame,
Ne ſtrive to win renown, or paſs the reſt:
With ſhepherds fits not follow flying fame,
But feed his flocks in fields, where falls him beſt.
I wot my rimes been rough, and rudely dreſt;
The fitter they, my careful caſe to frame:
Enough is me to paint out my unreſt,
And pour my piteous plaints out in the ſame.
The god of ſhepherds, Tityrus, is dead,
Who taught me homely, as I can, to make:
He, whilſt he liv'd, was the ſovereign head
Of ſhepherds all, that been with love ytake.
Well couth he wail his woes, and lightly ſlake
The flames which love within his heart had bred,
And tell us merry tales to keep us wake,
The while our ſheep about us ſafely fed.
Now dead he is, and lieth wrapt in lead,
(Oh why ſhould death on him ſuch outrage ſhow!)
And all his paſſing ſkill with him is fled,
The fame whereof doth daily greater grow.
But if on me ſome little drops would flow
Of that the ſpring was in his learned hed,
I ſoon would learn theſe woods to wail my woe,
And teach the trees their trickling tears to ſhed.
Then ſhould my plaints, caus'd of diſcourteſee,
As meſſengers of this my painful flight,
Fly to my love, wherever that ſhe be,
And pierce her heart with point of worthy wight;
As ſhe deſerves, that wrought ſo deadly ſpight.
And thou, Menalcas, that by treachery
Didſt underfong my laſs to wax ſo light,
Should'ſt well be known for ſuch thy villany.
But ſince I am not, as I wiſh I were,
Ye gentle ſhepherds, which your flocks do feed,
Whether on hills or dales, or other where,
Bear witneſs all of this ſo wicked deed:
And tell the laſs, whoſe flower is woxe a weed,
And faultleſs faith is turn'd to faithleſs ſeere,
That ſhe the trueſt ſhepherd's heart made bleed,
That lives on earth, and loved her moſt dear.
Hob. O! careful Colin, I lament thy caſe,
Thy tears would make the hardeſt flint to flow!
Ah! faithleſs Roſalind, and void of grace,
That art the root of all this rueful woe!
But now is time, I gueſs, homeward to go;
Then riſe, ye bleſſed flocks, and home apace,
Leſt night with ſtealing ſteps do you foreſlo,
And wet your tender lambs that by you trace.

By the following eclogue the reader will perceive that Mr Philips has, in imitation of Spencer, preſerved in his paſtorals many antiquated words, which, though they are diſcarded from polite converſation, may naturally be ſuppoſed ſtill to have place among the ſhepherds and other ruſtics in the country. We have made choice of his ſecond eclogue, becauſe it is brought home to his own buſineſs, and contains a complaint againſt thoſe who had ſpoken ill of him and his writings.

142 Philips.

THENOT, COLINET.

Th. Is it not Colinet I loneſome ſee
Leaning with folded arms againſt the tree?
Or is it age of late bedims my ſight?
'Tis Colinet, indeed in woful plight.
Thy cloudy look, why melting into tears,
Unſeemly, now the ſky ſo bright appears?
Why in this mournful manner art thou found,
Unthankful lad, when all things ſmile around?
Or hear'ſt not lark and linnet jointly ſing,
Their notes blithe warbling to ſalute the ſpring?
Co. Tho' blithe their notes, not ſo my wayward fate;
Nor lark would ſing, nor linnet, in my ſtate.
Each creature, Thenot to his taſk is born;
As they to mirth and muſic, I to mourn.
Waking, at midnight, I my woes renew,
My tears oft mingling with the falling dew.
Th. Small cauſe, I ween, has luſty youth to plain;
Or who may then the weight of eld ſuſtain,
When ev'ry ſlackening nerve begins to fail,
And the load preſſeth as our days prevail?
Yet though with years my body downward tend,
As trees beneath their fruit in autumn bend,
Spite of my ſnowy head and icy veins,
My mind a cheerful temper ſtill retains:
And why ſhould man, miſhap what will, repine,
Sour ev'ry ſweet, and mix with tears his wine?
But tell me then; it may relieve thy woe,
To let a friend thine inward ailment know.
Co. Idly 'twill waſte thee, Thenot, the whole day,
Should'ſt thou give ear to all my grief can ſay.
Thine ewes will wander; and the heedleſs lambs,
In loud complaints, require their abſent dams.
Th. See Lightfoot; he ſhall tend them cloſe: and I,
'Tween whiles, acroſs the plain will glance mine eye.
Co. Where to begin I know not, where to end.
Does there one ſmiling hour my youth attend?
Though few my days, as well my follies ſhow,
Yet are thoſe days all clouded o'er with wo:
No happy gleam of ſunſhine doth appear,
My low'ring ſky and wintry months to cheer.
My piteous plight in yonder naked tree,
Which bears the thunder-ſcar too plain, I ſee:
Quite deſtitute it ſtands of ſhelter kind,
The mark of ſtorms, and ſport of every wind:

The riven trunk feels not the approach of ſpring;
Nor birds among the leafleſs branches ſing:
No more, beneath thy ſhade, ſhall ſhepherds throng
With jocund tale, or pipe, or pleaſing ſong.
Ill fated tree! and more ill-fated I!
From thee, from me, alike the ſhepherds fly.
Th. Sure thou in hapleſs hour of time waſt born,
When blightning mildews ſpoil the riſing corn,
Or blaſting winds o'er bloſſom'd hedge-rows paſs,
To kill the promis'd fruits, and ſcorch the graſs;
Or when the moon, by wizzard charm'd, foreſhows,
Blood-ſtain'd in foul eclipſe, impending woes.
Untimely born, ill luck betides thee ſtill.
Co. And can there, Thenot, be a greater ill?
Th. Nor fox, nor wolf, nor rot among our ſheep:
From theſe good ſhepherd's care his flock may keep:
Againſt ill luck, alas! all forecaſt fails;
Nor toil by day, nor watch by night, avails.
Co. Ah me the while! ah me the luckleſs day!
Ah luckleſs lad! befits me more to ſay.
Unhappy hour! when freſh in youthful bud,
I left, Sabrina fair, thy ſilv'ry flood.
Ah ſilly I! more ſilly than my ſheep,
Which on thy flow'ry banks I wont to keep.
Sweet are thy banks; oh, when ſhall I once more
With raviſh'd eyes review thine amell'd ſhore?
When, in the cryſtal of thy waters, ſcan
Each feature faded, and my colour wan?
When ſhall I ſee my hut, the ſmall abode
Myſelf did raiſe and cover o'er with ſod?
Small though it be, a mean and humble cell,
Yet is there room for peace and me to dwell.
Th. And what enticement charm'd thee far away
From thy lov'd home, and led thy heart aſtray?
Co. A lewd deſire ſtrange lands and ſwains to know.
Ah me! that ever I ſhould covet wo!
With wand'ring feet unbleſt, and fond of fame,
I ſought I know not what beſides a name.
Th. Or, ſooth to ſay, didſt thou not hither rome
In ſearch of gains more plenty than at home?
A rolling ſtone is ever bare of moſs;
And, to their coſt, green years old proverbs croſs.
Co. Small need there was, in random ſearch of gain,
To drive my pining flock athwart the plain
To diſtant Cam. Fine gain at length, I trow,
To hoard up to myſelf ſuch deal of wo!
My ſheep quite ſpent through travel and ill fare,
And like their keeper, ragged grown and bare,
The damp cold green ſward for my nightly bed,
And ſome ſlaunt willow's trunk to reſt my head.
Hard is to bear of pinching cold the pain;
And hard is want to the unpractis'd ſwain;
But neither want, nor pinching cold is hard,
To blaſting ſtorms of calumny compar'd:
Unkind as hail it falls; the pelting ſhow'r
Deſtroys the tender herb and budding flow'r.
Th. Slander we ſhepherds count the vileſt wrong:
And what wounds ſorer than an evil tongue?
Co. Untoward lads, the wanton imps of ſpite
Make mock of all the ditties I endite.
In vain, O Colinet, thy pipe, ſo ſhrill,
Charms every vale, and gladdens every hill:
In vain thou ſeek'ſt the coverings of the grove,
In the cool ſhade to ſing the pains of love:
Sing what thou wilt, ill-nature will prevail;
And every elf hath ſkill enough to rail.
But yet, though poor and artleſs be my vein,
Menalcas ſeems to like my ſimple ſtrain:
And while that he delighteth in my ſong,
Which to the good Menalcas doth belong,
Nor night nor day ſhall my rude muſic ceaſe;
I aſk no more, ſo I Menalcas pleaſe.
Th. Menalcas, lord of theſe fair fertile plains,
Preſerves the ſheep, and o'er the ſhepherds reigns:
For him our yearly wakes and feaſts we hold,
And chooſe the faireſt firſtlings from the fold;
He, good to all who good deſerves, ſhall give
Thy flock to feed, and thee at eaſe to live,
Shall curb the malice of unbridled tongues,
And bounteouſly reward thy rural ſongs.
Co. Firſt then ſhall lightſome birds forget to fly,
The briny ocean turn to paſtures dry,
And every rapid river ceaſe to flow,
Ere I unmindful of Menalcas grow.
Th. This night thy care with me forget, and fold
Thy flock with mine, to ward th' injurious cold.
New milk, and clouted cream, mild cheeſe and curd,
With ſome remaining fruit of laſt year's hoard,
Shall be our ev'ning fare; and for the night,
Sweet herbs and moſs, which gentle ſleep invite:
And now behold the ſun's departing ray,
O'er yonder hill, the ſign of ebbing day:
With ſongs the jovial hinds return from plow;
And unyok'd heifers, loitering homeward, low.

Mr Pope's Paſtorals next appeared, but in a different dreſs from thoſe of Spencer and Philips; for he has diſcarded all antiquated words, drawn his ſwains more modern and polite, and made his numbers exquiſitely harmonious: his eclogues therefore may be called *better poems*, but not better paſtorals. We ſhall inſert the eclogue he has inſcribed to Mr Wycherly, the beginning of which is in imitation of Virgil's firſt paſtoral.

143
Pope.

Beneath the ſhade a ſpreading beech diſplays,
Hylas and Ægon ſung their rural lays:
This mourn'd a faithleſs, that an abſent love,
And Delia's name and Doris fill'd the grove,
Ye Mantuan nymphs, your ſacred ſuccour bring;
Hylas and Ægon's rural lays I ſing.
Thou, whom the nine with Plautus' wit inſpire,
The art of Terence, and Menander's fire:
Whoſe ſenſe inſtructs us, and whoſe humour charms,
Whoſe judgment ſways us, and whoſe ſpirit warms!
Oh, ſkill'd in nature! ſee the hearts of ſwains,
Their artleſs paſſions, and their tender pains.
Now ſetting Phœbus ſhone ſerenely bright,
And fleecy clouds were ſtreak'd with purple light;
When tuneful Hylas, with melodious moan,
Taught rocks to weep, and made the mountains groan.
Go, gentle gales, and bear my ſighs away!
To Delia's ear the tender notes convey,
As ſome ſad turtle his loſt love deplores,
And with deep murmurs fills the ſounding ſhores;
Thus, far from Delia, to the winds I mourn,
Alike unheard, unpity'd, and forlorn.
Go, gentle gales, and bear my ſighs along!
For her the feather'd quires neglect their ſong;
For her, the limes their pleaſing ſhades deny;
For her, the lilies hang their head and die,

Ye flow'rs that droop, forſaken by the ſpring ;
Ye birds, that left by ſummer ceaſe to ſing ;
Ye trees, that fade when autumn-heats remove ;
Say, is not abſence death to thoſe who love ?
Go, gentle gales, and bear my ſighs away !
Curs'd be the fields that cauſe my Delia's ſtay :
Fade ev'ry bloſſom, wither ev'ry tree,
Die ev'ry flow'r and periſh all but ſhe.
What have I ſaid ? where'er my Delia flies,
Let ſpring attend, and ſudden flow'rs ariſe ;
Let opening roſes knotted oaks adorn,
And liquid amber drop from ev'ry thorn.
Go, gentle gales, and bear my ſighs along !
The birds ſhall ceaſe to tune their ev'ning ſong,
The winds to breathe, the waving woods to move,
And ſtreams to murmur, ere I ceaſe to love.
Not bubbling fountains to the thirſty ſwain,
Not balmy ſleep to lab'rers faint with pain,
Not ſhow'rs to larks, or ſunſhine to the bee,
Are half ſo charming as thy ſight to me.
Go, gentle gales, and bear my ſighs away !
Come, Delia, come ! ah, why this long delay ?
Through rocks and caves the name of Delia ſounds ;
Delia, each cave and echoing rock rebounds.
Ye pow'rs, what pleaſing frenzy ſooths my mind !
Do lovers dream, or is my Delia kind ?
She comes, my Delia comes !—now ceaſe, my lay ;
And ceaſe, ye gales to bear my ſighs away !
Next Ægon ſung, while Windſor groves admir'd ;
Rehearſe, ye muſes, what yourſelves inſpir'd.
Reſound, ye hills, reſound my mournful ſtrain !
Of perjur'd Doris, dying, I complain :
Here where the mountains, leſs'ning as they riſe,
Loſe the low, vales, and ſteal into the ſkies ;
While lab'ring oxen, ſpent with toil and heat,
In their looſe traces from the field retreat ;
While curling ſmokes from village tops are ſeen,
And the fleet ſhades glide o'er the duſky green.
Reſound, ye hills, reſound my mournful lay !
Beneath yon poplar oft we paſs'd the day :
Oft on the rind I carv'd her am'rous vows,
While ſhe with garlands hung the bending boughs :
The garlands fade, the boughs are worn away ;
So dies her love, and ſo my hopes decay.
Reſound, ye hills, reſound my mournful ſtrain !
Now bright Arcturus glads the teeming grain ;
Now golden fruits in loaded branches ſhine,
And grateful cluſters, ſwell with floods of wine ;
Now bluſhing berries paint the yellow grove :
Juſt Gods ! ſhall all things yield returns but love ?
Reſound, ye hills, reſound my mournful lay !
The ſhepherds cry, " Thy flocks are left a prey."——
Ah ! what avails it me the flocks to keep,
Who loſt my heart, while I preſerv'd my ſheep,
Pan came, and aſk'd, what magic caus'd my ſmart,
Or what ill eyes malignant glances dart ?
What eyes but hers, alas ! have pow'r to move ?
And is there magic but what dwells in love ?
Reſound, ye hills, reſound my mournful ſtrains !
I'll fly from ſhepherds, flocks, and flow'ry plains.——
From ſhepherds, flocks, and plains, I may remove,
Forſake mankind, and all the world— but love !
I know thee, Love ! wild as the raging main,
More fell than tygers on the Lybian plain :
Thou wert from Ætna's burning entrails torn,
Got by fierce whirlwinds, and in thunder born.
Reſound, ye hills, reſound my mournful lay !
Farewell ye woods, adieu the light of day !
One leap from yonder cliff ſhall end my pains.
No more, ye hills, no more reſound my ſtrains !
Thus ſung the ſhepherds till th' approach of night,
The ſkies yet bluſhing with departing light,
When falling dews with ſpangles deck'd the glade,
And the low ſun had lengthen'd ev'ry ſhade.

To theſe paſtorals, which are written agreeably to the taſte of antiquity, and the rules above preſcribed, we ſhall beg leave to ſubjoin another that may be called *burleſque paſtoral*, wherein the ingenious author, Mr Gay, has ventured to deviate from the beaten road, and deſcribed the ſhepherds and ploughmen of our own time and country, inſtead of thoſe of the golden age, to which the modern critics confine the paſtoral. His ſix paſtorals, which he calls the *Shepherd's Week*, are a beautiful and lively repreſentation of the manners, cuſtoms, and notions of our ruſtics. We ſhall inſert the firſt of them, intitled *The Squabble*, wherein two clowns try to outdo each other in ſinging the praiſes of their ſweethearts, leaving it to a third to determine the controverſy. The perſons named are *Lobbin Clout*, *Cuddy*, and *Cloddipole*.

144
Gay.

Lob. Thy younglings, Cuddy, are but juſt awake ;
No throſtle ſhrill the bramble-buſh forſake ;
No chirping lark the welkin ſheen * invokes ;
No damſel yet the ſwelling udder ſtrokes ;
O'er yonder hill does ſcant † the dawn appear ;
Then why does Cuddy leave his cott ſo rear ‡ ?
Cud. Ah Lobbin Clout ! I ween ‖ my plight is gueſt ;
For *he that loves, a ſtranger is to reſt*.
If ſwains belye not, thou haſt prov'd the ſmart,
And Blouzalinda's miſtreſs of thy heart.
This riſing tear betokeneth well thy mind ;
Thoſe arms are folded for thy Blouzalind.
And well, I trow, our piteous plights agree ;
Thee Blouzalinda ſmites, Buxoma me.
Lob. Ah Blouzalind ! I love thee more by half,
Than deer their fawns, or, cows the new-fall'n calf,
Woe worth the tongue, may bliſters ſore it gall,
That names *Buxoma Blouzalind* withal !
Cud. Hold, witleſs Lobbin Clout, I thee adviſe,
Leſt bliſters ſore on thy own tongue ariſe.
Lo yonder Cloddipole, the blithſome ſwain,
The wiſeſt lout of all the neighb'ring plain !
From Cloddipole we learnt to read the ſkies,
To know when hail will fall or winds ariſe.
He taught us erſt * the heifer's tail to view,
When ſtuck aloft, that ſhow'rs would ſtraight enſue :
He firſt that uſeful ſecret did explain,
That pricking-corns foretold the gath'ring rain.
When ſwallows fleet ſoar high and ſport in air,
He told us that the welkin would be clear.
Let Cloddipole then hear us twain rehearſe,
And praiſe his ſweetheart in alternate verſe.
Ill wager this ſame oaken ſtaff with thee,
That Cloddipole ſhall give the prize to me.
Lob. See this tobacco-pouch, that's lin'd with hair,
Made of the ſkin of ſleekeſt fallow deer :
This pouch, that's tied with tape of reddeſt hue,
I'll wager, that the prize ſhall be my due.

Cud.

* Shining or bright ſky.
† Scarce.
‡ Early.
‖ Conceive.

* Formerly

Cud. Begin thy carrols, then, thou vaunting-ſlouch;
Be thine the oaken ſtaff, or mine the pouch.
Lob. My Blouzalinda is the blitheſt laſs,
Than primroſe ſweeter, or the clover-graſs.
Fair is the king-cup that in meadow blows,
Fair is the daiſy that beſide her grows;
Fair is the gilly-flow'r of gardens ſweet;
Fair is the marygold, for pottage meet:
But Blouzalind's than gilly-flow'r more fair,
Then daiſy, marygold, or king-cup rare.
Cud. My brown Buxoma is the feateſt maid
That e'er at wake delight ſome gambol play'd;
Clean as young lambkins, or the gooſe's down,
And like the goldfinch in her Sunday gown.
The witleſs lamb may ſport upon the plain,
The friſking kid delight the gaping ſwain;
The wanton calf may ſkip with many a bound,
And my our Tray play defteſt † feats around:
But neither lamb, nor kid, nor calf, nor Tray,
Dance like Buxoma on the firſt of May.
Lob. Sweet is my toil when Blouzalind is near;
Of her bereft, 'tis winter all the year.
With her no ſultry ſummer's heat I know;
In winter, when ſhe's nigh, with love I glow.
Come, Blouzalinda, eaſe thy ſwain's deſire,
My ſummer's ſhadow, and my winter's fire!
Cud. As with Buxoma once I work'd at hay,
E'en noon-tide labour ſeem'd an holiday;
And holidays, if haply ſhe were gone,
Like work-days I wiſh'd would ſoon be done.
Eftſoons ‡, O ſweetheart kind, my love repay,
And all the year ſhall then be holiday.
Lob. As Blouzalinda, in a gameſome mood,
Behind a haycock loudly laughing ſtood,
I ſlily ran and ſnatch'd a haſty kiſs;
She wip'd her lips nor took it much amiſs.
Believe me, Cuddy, while I'm bold to ſay,
Her breath was ſweeter than the ripen'd hay.
Cud. As my Buxoma, in a morning fair,
With gentle finger ſtroak'd her milky care,
I quaintly || ſtole a kiſs; at firſt, 'tis true,
She frown'd, yet after granted one or two,
Lobbin, I ſwear, believe who will my vows,
Her breath by far excell'd the breathing cows.
Lob. Leek to the Welſh, to Dutchmen butter's dear,
Of Iriſh ſwains potatoes are the cheer;
Oats for their feaſts the Scottiſh ſhepherds grind,
Sweet turnips are the food of Blouzalind:
While ſhe loves turnips, butter I'll deſpiſe,
Nor leeks, nor oatmeal, nor potatoes prize.
Cud. In good roaſt beef my landlord ſticks his knife,
The capon fat delights his dainty wife;
Pudding our parſon eats, the ſquire loves hare;
But white-pot thick is my Buxoma's fare.
While ſhe loves white-pot, capon ne'er ſhall be,
Nor hare, nor beef, nor pudding, food for me.
Lob. As once I play'd at blind man's buff, it hapt
About my eyes the towel thick was wrapt:
I miſs'd the ſwains, and ſeiz'd on Blouzalind;
True ſpeaks that ancient proverb, Love is blind.
Cud. As at hot-cockles once I laid me down,
And felt the weighty hand of many a clown;
Buxoma gave a gentle tap, and I
Quick roſe, and read ſoft miſchief in her eye.
Lob. On two near elms the ſlacken'd cord I hung;
Now high, now low, my Blouzalinda ſwung;

† Nimbleſt.

‡ Very ſoon.

|| Waggiſhly.

With the rude wind her rumpled garment roſe,
And ſhow'd her taper leg and ſcarlet hoſe.
Cud. Acroſs the fallen oak the plank I laid,
And myſelf pois'd againſt the tott'ring maid!
High leapt the plank, and down Buxoma fell;
I ſpy'd—but faithful ſweethearts never tell.
Lob. This riddle, Cuddy, if thou canſt, explain,
This wily riddle, puzzles every ſwain:
What flow'r is that which bears the virgin's name,
The richeſt metal joined with the ſame * ?
Cud. Anſwer, thou carle, and judge this riddle right,
I'll frankly own thee for a cunning wight.
What flow'r is that which royal honour craves,
Adjoin the virgin, and 'tis ſtrown on graves † ?
Clod. Forbear, contending louts, give o'er your ſtrains;
An oaken ſtaff each merits for his pains.
But ſee the ſun-beams bright to labour warn,
And gild the thatch of goodman Hodge's barn
Your herds for want of water ſtand a-dry;
They're weary of your ſongs—and ſo am I.

* Marygold.

† Roſemary.

We have given the rules uſually laid down for paſtoral writing, and exhibited ſome examples written on this plan; but we have to obſerve, that this poem may take very different forms. It may appear either as a comedy or as a ballad. As a paſtoral comedy, there is perhaps nothing which poſſeſſes equal merit with Ramſay's *Gentle Shepherd*, and we know not where to find in any language a rival to the *Paſtoral Ballad* of Shenſtone. That the excellence of this poem is great can hardly be queſtioned, ſince it compelled a critic, who was never laviſh of his praiſe, and who on all occaſions was ready to vilify the paſtoral, to expreſs himſelf in terms of high encomium, "In the firſt part (ſays he) are two paſſages, to which if any mind denies its ſympathy, it has no acquaintance with love or nature:

145 Shenſtone.

I priz'd every hour that went by,
  Beyond all that had pleas'd me before;
But now they are paſt, and I ſigh,
  And I grieve that I priz'd them no more.
When forc'd the fair nymph to forego,
  What anguiſh I felt in my heart!
Yet I thought—but it might not be ſo,
  'Twas with pain that ſhe ſaw me depart
She gaz'd, as I ſlowly withdrew,
  My path I could harly diſcern;
So ſweetly ſhe bade me adieu,
  I thought that ſhe bade me return.

"In the ſecond (continues the ſame critic) this paſſage has its prettineſs, though it be not equal to the former:"

I have found out a gift for my fair;
  I have found where the wood-pigeons breed;
But let me that plunder forbear,
  She would ſay 'twas a barbarous deed:
For he ne'er could be true ſhe averr'd,
  Who could rob a poor bird of its young;
And I lov'd her the more when I heard
  Such tenderneſs fall from her tongue.

SECT. V. *Of Didactic or Preceptive Poetry.*

146 Origin and uſe of didactic poetry.

THE method of writing precepts in verſe, and embelliſhing them with the graces of poetry, had its riſe, we may ſuppoſe, from a due conſideration of the frailties

ties and perverſeneſs of human nature; and was intended to engage the affections, in order to improve the mind and amend the heart.

Didactic or preceptive poetry, has been uſually employed either to illuſtrate and explain our moral duties, our philoſophical inquiries, our buſineſs and pleaſures; or in teaching the art of criticiſm or poetry itſelf. It may be adapted, however to any other ſubject; and may in all caſes, where inſtruction is deſigned, be employed to good purpoſe. Some ſubjects, indeed, are more proper than others, as they admit of more poetical ornaments, and give a greater latitude to genius: but whatever the ſubject is, thoſe precepts are to be laid down that are the moſt uſeful; and they ſhould follow each other in a natural eaſy method, and be delivered in the moſt agreeable engaging manner. What the proſe writer tells you ought to be done, the poet often conveys under the form of a narration, or ſhows the neceſſity of in a deſcription; and by repreſenting the action as done, or doing, conceals the precept that ſhould enforce it. The poet likewiſe, inſtead of telling the whole truth, or laying down all the rules that are requiſite, ſelects ſuch parts only as are the moſt pleaſing and communicates the reſt indirectly, without giving us an open view of them; yet takes care that nothing ſhall eſcape the reader's notice with which he ought to be acquainted. He diſcloſes juſt enough to lead the imagination into the parts that are concealed; and the mind, ever gratified with its own diſcoveries, is complimented with exploring and finding them out; which though done with eaſe, ſeems ſo conſiderable, as not to be obtained but in conſequence of its own adroitneſs and ſagacity.

147 Rules to be obſerved in its compoſition.

But this is not ſufficient to render didactic poetry always pleaſing: for where precepts are laid down one after another, and the poem is of conſiderable length, the mind will require ſome recreation and refreſhment by the way; which is to be procured by ſeaſonable moral reflections, pertinent remarks, familiar ſimilies, and deſcriptions naturally introduced, by alluſions to ancient hiſtories or fables, and by ſhort and pleaſant digreſſions and excurſions into more noble ſubjects ſo aptly brought in, that they may ſeem to have a remote relation, and be of a piece with the poem. By thus varying the form of inſtruction, the poet gives life to his precepts, and awakens and ſecures our attention without permitting us to ſee by what means we are thus captivated: and his art is the more to be admired, becauſe it is ſo concealed as to eſcape the reader's obſervation.

The ſtyle, too, muſt maintain a dignity ſuitable to the ſubject, and every part be drawn in ſuch lively colours, that the things deſcribed may ſeem as if preſented to the reader's view.

But all this will appear more evident from example; and though entire poems of this kind are not within the compaſs of our deſign, we ſhall endeavour to ſelect ſuch paſſages as will be ſufficient to illuſtrate the rules we have here laid down.

We have already obſerved, that, according to the uſual diviſions, there are four kinds of didactic poems, viz. thoſe that reſpect our moral duties, our philoſophical ſpeculations, our buſineſs and pleaſures, or that give precepts for poetry and criticiſm.

I. On the firſt ſubject, indeed, we have ſcarce any thing that deſerves the name of poetry, except Mr Pope's *Eſſay on Man*, his *Ethic Epiſtles*, Blackmore's *Creation*, and part of Young's *Night Thoughts*; to which therefore we refer as examples.

II. Thoſe preceptive poems that concern philoſophical ſpeculations, though the ſubject is ſo pregnant with matter, affords ſuch a field for fancy, and is ſo capable of every decoration, are but few. Lucretius is the moſt conſiderable among the ancients who has written in this manner; among the moderns we have little elſe but ſmall detached pieces, except the poem called *Anti-Lucretius*, which has not yet received an Engliſh dreſs; Dr Akenſide's *Pleaſures of the Imagination*, and Dr Darwin's *Botanic Garden*; which are all worthy of our admiration. Some of the ſmall pieces in this department are alſo well executed; and there is one entitled the *Univerſe*, written by Mr Baker, from which we ſhall borrow an example.

The author's ſcheme is in ſome meaſure coincident with Mr Pope's, ſo far eſpecially as it tends to reſtrain the pride of man, with which deſign it was profeſſedly written.

The paſſage we have ſelected is that reſpecting the planetary ſyſtem.

148 Examples in didactic poetry.

Unwiſe! and thoughtleſs! impotent! and blind!
Can wealth, or grandeur, ſatisfy the mind?
Of all thoſe pleaſures mortals moſt admire,
Is there one joy ſincere, that will not tire?
Can love itſelf endure? or beauty's charms
Afford that bliſs we fancy in its arms?—
Then, let thy ſoul more glorious aims purſue:
Have thy CREATOR and his works in view.
Be theſe thy ſtudy: hence thy pleaſures bring:
And drink large draughts of wiſdom from its ſpring;
That ſpring, whence perfect joy, and calm repoſe.
And bleſt content, and peace eternal, flows.
  Obſerve how regular the planets run,
In ſtated times, their courſes round the Sun.
Diff'rent their bulk, their diſtance, their career,
And diff'rent much the compaſs of their year:
Yet all the ſame eternal laws obey,
While God's unerring finger points the way.
  Firſt Mercury, amidſt full tides of light,
Rolls next the ſun, through his ſmall circle bright.
All that dwell here muſt be refin'd and pure:
Bodies like ours ſuch ardour can't endure:
Our earth would blaze beneath ſo fierce a ray,
And all its marble mountains melt away.
  Fair Venus, next, fulfils her larger round,
With ſofter beams, and milder glory crown'd.
Friend to mankind, ſhe glitters from afar,
Now the bright ev'ning, now the morning ſtar.
  More diſtant ſtill, our earth comes rolling on,
And forms a wider circle round the Sun:
With her the moon, companion ever dear!
Her courſe attending through the ſhining year.
  See, Mars, alone, runs his appointed race,
And meaſures out, exact, the deſtin'd ſpace:
Nor nearer does he wind, nor further ſtray,
But finds the point whence firſt he roll'd away.
  More yet remote from day's all-cheering ſource,
Vaſt Jupiter performs his conſtant courſe:
Four friendly moons, with borrow'd luſtre, riſe,
Beſtow their beams divine, and light his ſkies.
  Fartheſt and laſt, ſcarce warm'd by Phœbus' ray,
Through his vaſt orbit Saturn wheels away.

How great the change could we be wafted there!
How ſlow the ſeaſons! and how long the year!
One moon, on us, reflects its cheerful light:
There, five attendants brighten up the night.
Here, the blue firmament bedeck'd with ſtars;
There, over-head, a lucid arch appears. [ball!
From hence, how large, how ſtrong, the ſun's bright
But ſeen from thence, how languid and how ſmall!—
When the keen north with all its fury blows,
Congeals the floods, and forms the fleecy ſnows,
'Tis heat intenſe to what can there be known:
Warmer our poles than is its burning zone.
Who [illegible]habit muſt have other pow'rs,
Juices, [illegible]s, and ſenſe, and life, than ours.
One mo[illegible] cold, like theirs, would pierce the bone,
Freeze the heart-blood, and turn us all to ſtone.
Strange and amazing muſt the diff'rence be
'Twixt this dull planet and bright Mercury:
Yet reaſon ſays, nor can we doubt at all,
Millions of beings dwell on either ball,
With conſtitutions fitted for that ſpot,
Where Providence, all-wiſe, has fix'd their lot.
Wondrous art thou, O God, in all thy ways!
Their eyes to thee let all thy creatures raiſe;
Adore thy grandeur, and thy goodneſs praiſe.
Ye ſons of men! with ſatisfaction know,
God's own right hand diſpenſes all below:
Nor good nor evil does by chance befall;
He reigns ſupreme, and he directs it all.
At his command, affrighting human kind,
Comets drag on their blazing lengths behind:
Nor, as we think, do they at random rove,
But, in determin'd times, through long ellipſes move.
And tho' ſometimes they near approach the ſun,
Sometimes beyond our ſyſtem's orbit run;
Throughout their race they act their Maker's will,
His pow'r declare, his purpoſes fulfil.

III. Of thoſe preceptive poems that treat of the buſineſs and pleaſures of mankind, Virgil's *Georgics* claim our firſt and principal attention. In theſe he has laid down the rules of huſbandry in all its branches with the utmoſt exactneſs and perſpicuity, and at the ſame time embelliſhed them with all the beauties and graces of poetry. Though his ſubject was huſbandry, he has delivered his precepts, as Mr Addiſon obſerves, not with the ſimplicity of a ploughman, but with the addreſs of a poet: the meaneſt of his rules are laid down with a kind of grandeur; *and he breaks the clods, and toſſes about the dung, with an air of gracefulneſs.* Of the different ways of conveying the ſame truth to the mind, he takes that which is pleaſanteſt; and this chiefly diſtinguiſhes poetry from proſe, and renders Virgil's rules of huſbandry more deligtful and valuable than any other.

Theſe poems, which are eſteemed the moſt perfect of the author's works, are, perhaps, the beſt that can be propoſed for the young ſtudent's imitation in this manner of writing; for the whole of his *Georgics* is wrought up with wonderful art, and decorated with all the flowers of poetry.

IV. Of thoſe poems which give precepts for the recreations and pleaſures of a country life, we have ſeveral in our own language that are juſtly admired. As the moſt conſiderable of thoſe diverſions, however, are finely treated by Mr Gay in his *Rural Sports*, we particularly refer to that poem.

We ſhould here treat of thoſe preceptive poems that teach the art of poetry itſelf, of which there are many that deſerve particular attention; but we have anticipated our deſign, and rendered any farther, notice of them in a manner uſeleſs, by the obſervations we have made in the courſe of this treatiſe. We ought however to remark, that Horace was the only poet among the ancients who wrote precepts for poetry in verſe; at leaſt his epiſtle to the Piſos is the only piece of the kind that has been handed down to us; and that is ſo perfect, it ſeems almoſt to have precluded the neceſſity of any other. Among the moderns we have ſeveral that are juſtly admired; as Boileau, Pope, &c.

Poets who write in the preceptive manner ſhould take care to chooſe ſuch ſubjects as are worthy of their muſe, and of conſequence to all mankind; for to beſtow both parts and pains to teach people trifles that are unworthy of their attention, is to the laſt degree ridiculous.

Among poems of the uſeful and intereſting kind, Dr Armſtrong's *Art of Preſerving Health* deſerves particular recommendation, as well in conſideration of the ſubject, as of the elegant and maſterly manner in which he has treated it; for he has made thoſe things, which are in their own nature dry and unentertaining, perfectly agreeable and pleaſing, by adhering to the rules obſerved by Virgil and others, in the conduct of theſe poems.

149
Its proper ſtyle.

Warton on Didactic Poetry.

With regard to the ſtyle or dreſs of theſe poems, it ſhould be ſo rich as to hide the nakedneſs of the ſubject, and the barrenneſs of the precepts ſhould be loſt in the luſtre of the language. "It ought to abound in the moſt bold and forcible metaphors, the moſt glowing and pictureſque epithets; it ought to be elevated and enlivened by pomp of numbers and majeſty of words, and by every figure that can lift a language above the vulgar and current expreſſions." One may add, that in no kind of poetry (not even in the ſublime ode) is beauty of expreſſion ſo much to be regarded as in this. For the epic writer ſhould be very cautious of indulging himſelf in too florid a manner of expreſſion, eſpecially in the dramatic parts of his fable, where he introduces dialogue: and the writer of tragedy cannot fall into ſo nauſeous and unnatural an affectation, as to put laboured deſcriptions, pompous epithets, ſtudied phraſes, and high-flown metaphors, into the mouths of his characters. But as the didactic poet ſpeaks in his own perſon, it is neceſſary and proper for him to uſe a brighter colouring of ſtyle, and to be more ſtudious of ornament. And this is agreeable to an admirable precept of Ariſtotle, which no writer ſhould ever forget,—"That diction ought moſt to be laboured in the unactive, that is, the deſcriptive, parts of a poem, in which the opinions, manners, and paſſions of men are not repreſented; for too glaring an expreſſion obſcures the manners and the ſentiments."

We have already obſerved that any thing in nature may be the ſubject of this poem. Some things however will appear to more advantage than others, as they give a greater latitude to genius, and admit of more poetical ornaments. Natural hiſtory and philoſophy are copious ſubjects. Precepts in theſe might be decorated with all the flowers in poetry; and, as Dr Trap obſerves, how can poetry be better employed, or more agreeably to its nature and dignity, than in celebrating the works of the great Creator, and deſcribing the nature and generation of animals, vegetables, and minerals; the revolutions of the heavenly bodies; the motions of the earth; the flux and reflux of the ſea; the cauſe of thunder, lightning, and other meteors; the attraction of the magnet; the gravitation, cohesion, and repulſion of matter; the impulſive motion of light; the ſlow progreſſion of ſounds; and other amazing phenomena of nature? Moſt of the arts and ſciences are alſo proper ſubjects for this poem; and none are more ſo than its two ſiſter arts, painting and muſic. In the former, particularly, there is room for the moſt entertaining precepts concerning the diſpoſal of colours; the arrangement of lights and ſhades; the ſecret attractives of beauty; the various ideas which make up the one; the diſtinguiſhing between the attitudes proper to either ſex, and every paſſion; the repreſenting proſpects of buildings, battles, or the country; and laſtly, concerning the nature of imitation, and the power of painting. What a boundleſs field of invention is here? What room for deſcription, compariſon, and poetical fable? How eaſy the tranſition, at any time, from the draught to the original, from the ſhadow to the ſubſtance? and from hence, what noble excurſions may be made into hiſtory, into panegyric upon the greateſt beauties or heroes of the paſt or preſent age?

Sect. VI. *Of the Epiſtle.*

150 The character of the epiſtle.

This ſpecies of writing, if we are permitted to lay down rules from the examples of our beſt poets, admits of great latitude, and ſolicits ornament and decoration: yet the poet is ſtill to conſider, that the true character of the epiſtle is eaſe and elegance; nothing therefore ſhould be forced or unnatural, laboured, or affected, but every part of the compoſition ſhould breathe an eaſy, polite, and unconſtrained freedom.

It is ſuitable to every ſubject; for as the epiſtle takes place of diſcourſe, and is intended as a ſort of diſtant converſation, all the affairs of life and reſearches into nature may be introduced. Thoſe, however, which are fraught with compliment or condolence, that contain a deſcription of places, or are full of pertinent remarks, and in a familiar and humourous way deſcribe the manners, vices, and follies of mankind, are the beſt; becauſe they are moſt ſuitable to the true character of epiſtolary writing, and (buſineſs ſet apart) are the uſual ſubject upon which our letters are employed.

All farther rules and directions are unneceſſary; for this kind of writing is better learned by example and practice than by precept. We ſhall therefore in conformity to our plan, ſelect a few epiſtles for the reader's imitation; which, as this method of writing has of late much prevailed, may be beſt taken, perhaps, from our modern poets.

The following letter from Mr Addiſon to Lord Halifax, contains an elegant deſcription of the curioſities and places about Rome, together with ſuch reflections on the ineſtimable bleſſings of liberty as muſt give pleaſure to every Briton, eſpecially when he ſees them thus placed in direct oppoſition to the baneful influence of ſlavery and oppreſſion, which are ever to be ſe[illegible] among the miſerable inhabitants of thoſe countries.

151 Examples in epiſtolary poetry from Addiſon,

While you, my lord, the rural ſhades admire,
And from Britannia's public poſts retire,
Nor longer, her ungrateful ſons to pleaſe,
For their advantage ſacrifice your eaſe;
Me into foreign realms my fate conveys,
Through nations fruitful of immortal lays,
Where the ſoft ſeaſon and inviting clime
Conſpire to trouble your repoſe with rhim[illegible]
For whereſoe'er I turn my raviſh'd e[illegible]
Gay gilded ſcenes and ſhining proſpect[illegible]
Poetic fields encompaſs me around,
And ſtill I ſeem to tread on claſſic gro[illegible]
For here the muſe ſo oft her harp has [illegible]
That not a mountain rears its head un[illegible]
Renown'd in verſe each ſhady thicket g[illegible]
And ev'ry ſtream in heav'nly numbers f[illegible]
How am I pleas'd to ſearch the hills and woods
For riſing ſprings and celebrated floods;
To view the Nar, tumultuous in his courſe,
And trace the ſmooth Clitumnus to his ſource;
To ſee the Mincia draw its wat'ry ſtore
Through the long windings of a fruitful ſhore,
And hoary Albula's infected tide
O'er the warm bed of ſmoking ſulphur glide!
Fir'd with a thouſand raptures, I ſurvey
Eridanus thro' flow'ry meadows ſtray,
The king of floods! that, rolling o'er the plains,
The tow'ring Alps of half their moiſture drains,
And proudly ſwoln with a whole winter's ſnows,
Diſtributes wealth and plenty where he flows.
Sometimes, miſguided by the tuneful throng,
I look for ſtreams immortaliz'd in ſong,
That loſt in ſilence and oblivion lie,
(Dumb are their fountains and their channels dry)
Yet run for ever by the muſe's ſkill,
And in the ſmooth deſcription murmur ſtill.
Sometimes to gentle Tiber I retire,
And the fam'd river's empty ſhores admire,
That, deſtitute of ſtrength, derives its courſe
From thirſty urns, and an unfruitful ſource;
Yet ſung ſo often in poetic lays,
With ſcorn the Danube and the Nile ſurveys;
So high the deathleſs muſe exalts her theme!
Such was the Boyn, a poor inglorious ſtream,
That in Hibernian vales obſcurely ſtray'd,
And unobſerv'd in wild meanders play'd;
Till, by your lines, and Naſſau's ſword renown'd,
Its riſing billows through the world reſound,
Where'er the hero's godlike acts can pierce,
Or where the fame of an immortal verſe.
O cou'd the muſe my raviſh'd breaſt inſpire
With warmth like yours, and raiſe an equal fire,
Unnumber'd beauties in my verſe ſhould ſhine,
And Virgil's Italy ſhould yield to mine!
See how the golden groves around me ſmile,
That ſhun the coaſts of Britain's ſtormy iſle,
Or when tranſplanted and preſerv'd with care,
Curſe the cold clime, and ſtarve in northern air.
Here kindly warmth their mounting juice ferments
To nobler taſtes, and more exalted ſcents:
Ev'n the rough rocks with tender myrtles bloom,
And trodden weeds ſend out a rich perfume.

Bear

Epiſtle. Bear me, ſome god, to Baia's gentle ſeats,
Or cover me in Umbria's green retreats;
Where weſtern gales eternally reſide,
And all the ſeaſons laviſh all their pride:
Bloſſoms, and fruits, and flow'rs together riſe,
And the whole year in gay confuſion lies.
Immortal glories in my mind revive,
And in my ſoul a thouſand paſſions ſtrive,
When Rome's exalted beauties I deſcry
Magnificent in piles of ruin lie.
An amphitheatre's amazing height
Here fills my eye with terror and delight,
That on its public ſhows unpeopled Rome,
And held uncrowded nations in its womb:
Here pillars rough with ſculpture pierce the ſkies;
And here the proud triumphal arches riſe,
Where the old Romans deathleſs acts diſplay'd,
Their baſe degenerate progeny upbraid:
Whole rivers here forſake the fields below,
And wond'ring at their height thro' airy channels flow.
Still to new ſcenes my wand'ring muſe retires;
And the dumb ſhow of breathing rocks admires;
Where the ſmooth chiſſel all its force has ſhown,
And ſoften'd into fleſh the rugged ſtone.
In ſolemn ſilence, a majeſtic band,
Heroes, and gods, and Roman conſuls ſtand,
Stern tyrants, whom their cruelties renown,
And emperors in Parian marble frown;
While the bright dames, to whom they humbly ſu'd,
Still ſhow the charms that their proud hearts ſubdu'd.
Fain would I Raphael's godlike art rehearſe,
And ſhow th' immortal labours in my verſe,
Where from the mingled ſtrength of ſhade and light
A new creation riſes to my ſight,
Such heav'nly figures from his pencil flow,
So warm with life his blended colours glow.
From theme to theme with ſecret pleaſure toſt,
Amidſt the ſoft variety I'm loſt.
Here pleaſing airs my raviſh'd ſoul confound
With circling notes and labyrinths of ſound;
Here domes and temples riſe in diſtant views,
And opening palaces invite my muſe.
How has kind heav'n adorn'd the happy land,
And ſcatter'd bleſſings with a waſteful hand!
But what avail her unexhauſted ſtores,
Her blooming mountains, and her ſunny ſhores,
With all the gifts that heav'n and earth impart,
The ſmiles of nature, and the charms of art,
While proud oppreſſion in her valleys reigns,
And tyranny uſurps her happy plains!
The poor inhabitant beholds in vain
The red'ning orange and the ſwelling grain:
Joyleſs he ſees the growing oils and wines,
And in the myrtle's fragrant ſhade repines:
Starves, in the midſt of nature's bounty curſt,
And in the loaded vineyard dies for thirſt.
O liberty thou goddeſs heav'nly bright,
Profuſe of bliſs, and pregnant with delight!
Eternal pleaſures in thy preſence reign,
And ſmiling plenty leads thy wanton train;
Eas'd of her load, ſubjection grows more light,
And poverty looks cheerful in thy ſight;
Thou mak'ſt the gloomy face of nature gay,
Giv'ſt beauty to the ſun, and pleaſure to the day.
Thee, goddeſs, thee, Britannia's iſle adores; Epiſtle.
How has ſhe oft exhauſted all her ſtores,
How oft in fields of death thy preſence ſought,
Nor thinks the mighty prize too dearly bought!
On foreign mountains may the ſun refine
The grape's ſoft juice, and mellow it to wine,
With citron groves adorn a diſtant ſoil,
And the fat olive ſwell with floods of oil:
We envy not the warmer clime, that lies
In ten degrees of more indulgent ſkies,
Nor at the coarſeneſs of our heav'n repine,
Tho' o'er our heads the frozen Pleiads ſhine:
'Tis liberty that crowns Britannia's iſle,
And makes her barren rocks and her bleak mountains ſmile.
Others with tow'ring piles may pleaſe the ſight,
And in their proud aſpiring domes delight;
A nicer touch to the ſtretch'd canvas give,
Or teach their animated rocks to live:
'Tis Britain's care to watch o'er Europe's fate,
And hold in balance each contending ſtate,
To threaten bold preſumptuous kings with war,
And anſwer her afflicted neighbour's pray'r.
The Dane and Swede, rous'd up by fierce alarms,
Bleſs the wiſe conduct of her pious arms:
Soon as her fleets appear, their terrors ceaſe,
And all the northern world lies huſh'd in peace.
Th' ambitious Gaul beholds with ſecret dread
Her thunder aim'd at his aſpiring head,
And fain her godlike ſons would diſunite
By foreign gold, or by domeſtic ſpite;
But ſtrives in vain to conquer or divide,
Whom Naſſau's arms defend and counſels guide.
Fir'd with the name, which I ſo oft have found
The diſtant climes and diff'rent tongues reſound,
I bridle in my ſtruggling muſe with pain,
That longs to launch into a bolder ſtrain.
But I've already troubled you too long,
Nor dare attempt a more advent'rous ſong:
My humble verſe demands a ſofter theme,
A painted meadow or a purling ſtream;
Unfit for heroes; whom immortal lays,
And lines like Virgil's, or like yours, ſhould praiſe.

There is a fine ſpirit of freedom, and love of liberty, diſplayed in the following letter from Lord Lyttleton to Mr Pope; and the meſſage from the ſhade of Virgil, which is truly poetical, and juſtly preceptive, may prove an uſeful leſſon to future bards.

From Rome, 1730. 152

Immortal bard! for whom each muſe has wove Lyttleton.
The faireſt garlands of the Aonian grove;
Preſerv'd, our drooping genius to reſtore,
When Addiſon and Congreve are no more;
After ſo many ſtars extinct in night,
The darken'd age's laſt remaining light!
To thee from Latian realms this verſe is writ,
Inſpir'd by memory of ancient wit:
For now no more theſe climes their influence boaſt,
Fall'n is their glory, and their virtue loſt;
From tyrants, and from prieſts, the muſes fly,
Daughters of reaſon and of liberty.
Nor Baiæ now nor Umbria's plain they love,
Nor on the banks of Nar or Mincia rove;
To Thames's flow'ry borders they retire,
And kindle in thy breaſt the Roman fire.

So

Epiſtle.

So in the ſhades, where cheer'd with ſummer rays
Melodious linnets warbled ſprightly lays,
Soon as the faded, falling leaves complain
Of gloomy winter's inauſpicious reign,
No tuneful voice is heard of joy or love,
But mournful ſilence ſaddens all the grove.
Unhappy Italy! whoſe alter'd ſtate
Has felt the worſt ſeverity of fate:
Not that barbarian hands her faſces broke,
And bow'd her haughty neck beneath their yoke;
Nor that her palaces to earth are thrown,
Her cities deſert, and her fields unſown;
But that her ancient ſpirit is decay'd,
That ſacred wiſdom from her bounds is fled,
That there the ſource of ſcience flows no more,
Whence its rich ſtreams ſupply'd the world before.
Illuſtrious names! that once in Latium ſhin'd,
Born to inſtruct and to command mankind;
Chiefs, by whoſe virtue mighty Rome was rais'd,
And poets, who thoſe chiefs ſublimely prais'd!
Oft I the traces you have left explore,
Your aſhes viſit, and your urns adore;
Oft kiſs, with lips devout, ſome mould'ring ſtone,
With ivy's venerable ſhade o'ergrown;
Thoſe hallow'd ruins better pleas'd to ſee,
Than all the pomp of modern luxury.
As late on Virgil's tomb freſh flow'rs I ſtrow'd,
While with th' inſpiring muſe my boſom glow'd,
Crown'd with eternal bays, my raviſh'd eyes
Beheld the poet's awful form ariſe:
Stranger, he ſaid, whoſe pious hand has paid
Theſe grateful rites to my attentive ſhade,
When thou ſhalt breathe thy happy native air,
To Pope this meſſage from his maſter bear.
Great bard, whoſe numbers I myſelf inſpire,
To whom I gave my own harmonious lyre,
If high exalted on the throne of wit,
Near me and Homer thou aſpire to ſit,
No more let meaner ſatire dim the rays
That flow majeſtic from thy noble bays.
In all the flow'ry paths of Pindus ſtray:
But ſhun that thorny that unpleaſing way;
Nor, when each ſoft engaging muſe is thine,
Addreſs the leaſt attractive of the nine.
Of thee more worthy were the taſk to raiſe
A laſting column to thy country's praiſe,
To ſing the land which yet alone can boaſt
That liberty corrupted Rome has loſt;
Where ſcience in the arms of peace is laid,
And plants her palm beneath the olive's ſhade.
Such was the theme for which my lyre I ſtrung
Such was the people whoſe exploits I ſung;
Brave, yet refin'd, for arms and arts renown'd,
With diff'rent bays by Mars and Phœbus crown'd,
Dauntleſs oppoſers of tyrannic ſway,
But pleas'd a mild AUGUSTUS to obey.
If theſe commands ſubmiſſive thou receive,
Immortal and unblam'd thy name ſhall live.
Envy to black Cocytus ſhall retire,
And howl with furies in tormenting fire;
Approving time ſhall conſecrate thy lays,
And join the patriot's to the poet's praiſe.

The following letter from Mr Philips to the earl of Dorſet is entirely deſcriptive; but is one of thoſe deſcriptions which will be ever read with delight.

Epiſtle.
153
Philips, and

Copenhagen, March 9, 1709.

FROM frozen climes, and endleſs tracts of ſnow,
From ſtreams which northern winds forbid to flow,
What preſent ſhall the muſe to Dorſet bring,
Or how, ſo near the pole, attempt to ſing?
The hoary winter here conceals from ſight
All pleaſing objects which to verſe invite.
The hills and dales, and the delightful woods,
The flow'ry plains, and ſilver-ſtreaming floods,
By ſnow diſguis'd, in bright confuſion lie,
And with one dazzling waſte fatigue the eye.
No gentle breathing breeze prepares the ſpring,
No birds within the deſert region ſing:
The ſhips, unmov'd, the boiſt'rous winds defy,
While rattling chariots o'er the ocean fly.
The vaſt Leviathan wants room to play,
And ſpout his waters in the face of day:
The ſtarving wolves along the main ſea ſprowl,
And to the moon in icy valleys howl.
O'er many a ſhining league the level main
Here ſpreads itſelf into a glaſſy plain:
There ſolid billows of enormous ſize,
Alps of green ice, in wild diſorder riſe.
And yet but lately have I ſeen, ev'n here,
The winter in a lovely dreſs appear.
Ere yet the clouds let fall the treaſur'd ſnow,
Or winds began through hazy ſkies to blow,
At ev'ning a keen eaſtern breeze aroſe,
And the deſcending rain unſully'd froze;
Soon as the ſilent ſhades of night withdrew,
The ruddy morn diſclos'd at once to view
The face of nature in a rich diſguiſe,
And brighten'd ev'ry object to my eyes:
For ev'ry ſhrub, and ev'ry blade of graſs,
And ev'ry pointed thorn, ſeem'd wrought in glaſs;
In pearls and rubies rich the hawthorns ſhow,
While through the ice the crimſon berries glow.
The thick ſprung reeds, which watery marſhes yield,
Seem'd poliſh'd lances in a hoſtile field.
The ſtag in limpid currents with ſurpriſe,
Sees cryſtal branches on his forehead riſe:
The ſpreading oak, the beech, and tow'ring pine,
Glaz'd over, in the freezing æther ſhine.
The frighted birds the rattling branches ſhun,
Which wave and glitter in the diſtant ſun.
When if a ſudden guſt of wind ariſe,
The brittle foreſt into atoms flies,
The crackling woods beneath the tempeſt bends,
And in a ſpangled ſhower the proſpect ends:
Or, if a ſouthern gale the region warm,
And by degrees unbend the wint'ry charm,
The traveller a miry country ſees,
And journey ſad beneath the dropping trees:
Like ſome deluded peaſant Merlin leads
Thro' fragrant bow'rs and through delicious meads,
While here enchanted gardens to him riſe,
And airy fabrics there attract his eyes,
His wandering feet the magic paths purſue,
And while he thinks the fair illuſion true,
The trackleſs ſcenes diſperſe in fluid air,
And woods, and wilds, and thorny ways appear;
A tedious road the weary wretch returns,
And as he goes, the tranſient viſion mourns.

The great uſe of medals is properly deſcribed in the enſuing elegant epiſtle from Mr Pope to Mr Addiſon;

and the extravagant paſſion which ſome people entertain only for the colour of them, is very agreeably and very juſtly ridiculed.

154 Pope.

SEE the wild waſte of all devouring years!
How Rome her own ſad ſepulchre appears!
With nodding arches, broken temples ſpread!
The very tombs now vaniſh like their dead!
Imperial wonders rais'd on nations ſpoil'd,
Where mix'd with ſlaves the groaning martyr toil'd!
Huge theatres, that now unpeopled woods,
Now drain'd a diſtant country of her floods!
Fanes which admiring gods with pride ſurvey,
Statues of men, ſcarce leſs alive than they!
Some felt the ſilent ſtroke of mould'ring age,
Some hoſtile fury, ſome religious rage:
Barbarian blindneſs, Chriſtian zeal conſpire,
And papal piety, and Gothic fire.
Perhaps, by its own ruin ſav'd from flame,
Some bury'd marble half preſerves a name:
That name the learn'd with fierce diſputes purſue,
And give to Titus old Veſpaſian's due.
Ambition ſigh'd: She found it vain to truſt
The faithleſs column and the crumbling buſt;
Huge moles, whoſe ſhadow ſtretch'd from ſhore to ſhore,
Their ruins periſh'd, and their place no more!
Convinc'd, ſhe now contracts her vaſt deſign,
And all her triumphs ſhrink into a coin.
A narrow orb each crowded conqueſt keeps,
Beneath her palm here ſad Judea weeps;
Now ſcantier limits the proud arch confine,
And ſcarce are ſeen the proſtrate Nile or Rhine;
A ſmall Euphrates through the piece is roll'd,
And little eagles wave their wings in gold.
The medal, faithful to its charge of fame,
Through climes and ages bears each form and name:
In one ſhort view ſubjected to our eye,
Gods, emp'rors, heroes, ſages, beauties, lie.
With ſharpen'd ſight pale antiquaries pore,
Th' inſcription value, but the ruſt adore.
This the blue varniſh, that the green endears,
The ſacred ruſt of twice ten hundred years!
To gain Preſcennius one employs his ſchemes,
One graſps a Cecrops in ecſtatic dreams.
Poor Vadius, long with learned ſpleen devour'd,
Can taſte no pleaſure ſince his ſhield was ſcour'd:
And Curio, reſtleſs by the fair one's ſide,
Sighs for an Otho, and neglects his bride.
Their's is the vanity, the learning thine:
Touch'd by thy hand, again Rome's glories ſhine;
Her gods and god-like heroes riſe to view,
And all her faded garlands bloom anew.
Nor bluſh theſe ſtudies thy regard engage;
Theſe pleas'd the fathers of poetic rage;
The verſe and ſculpture bore an equal part,
And art reflected images to art.
Oh when ſhall Britain, conſcious of her claim,
Stand emulous of Greek and Roman fame?
In living medals ſee her wars enroll'd,
And vanquiſh'd realms ſupply recording gold?
Here, riſing bold, the patriot's honeſt face;
There, warriors frowning in hiſtoric braſs?
Then future ages with delight ſhall ſee
How Plato's, Bacon's, Newton's, looks agree;
Or in fair ſeries laurell'd bards be ſhown,
A Virgil there, and here an Addiſon.
Then ſhall thy CRAGGS (and let me call him mine)
On the caſt ore, another Pollio ſhine;
With aſpect open ſhall erect his head,
And round the orb in laſting notes be read,
" Stateſman, yet friend to truth! of ſoul ſincere,
" In action faithful, and in honour clear;
" Who broke no promiſe, ſerv'd no private end,
" Who gain'd no title, and who loſt no friend;
" Ennobled by himſelf, by all approv'd,
" Prais'd, wept, and honour'd, by the muſe he lov'd."

We have already obſerved, that the eſſential, and indeed the true characteriſtic of epiſtolary writing, is eaſe; and on this account as well as others, the following letter from Mr Pope to Miſs Blount is to be admired.

To Miſs BLOUNT, *on her leaving the Town after the Coronation.*

As ſome fond virgin, whom her mother's care
Drags from the town to wholeſome country air;
Juſt when ſhe learns to roll a melting eye,
And hear a ſpark, yet think no danger nigh;
From the dear man unwilling ſhe muſt ſever,
Yet takes one kiſs before ſhe parts for ever:
Thus from the world fair Zephalinda flew,
Saw others happy, and with ſighs withdrew:
Not that their pleaſures caus'd her diſcontent;
She ſigh'd, not that they ſtay'd, but that ſhe went.
She went, to plain-work, and to purling brooks,
Old-faſhion'd halls, dull aunts, and croaking rooks:
She went from op'ra, park, aſſembly, play,
To morning-walks, and pray'rs three hours a-day;
To part her time twixt reading and bohea,
To muſe, and ſpill her ſolitary tea,
Or o'er cold coffee trifle with the ſpoon,
Count the ſlow clock, and dine exact at noon;
Divert her eyes with pictures in the fire,
Hum half a tune, tell ſtories to the 'ſquire;
Up to her godly garret after ſeven,
There ſtarve and pray, for that's the way to heav'n.
Some 'ſquire, perhaps, you take delight to rack;
Whoſe game is whiſk, whoſe treat's a toaſt in ſack;
Who viſits with a gun, preſents you birds,
Then gives a ſmacking buſs, and cries,—no words!
Or with his hound comes hollowing from the ſtable,
Makes love with nods, and knees beneath a table;
Whoſe laughs are hearty, tho' his jeſts are coarſe,
And loves you beſt of all things—but his horſe.
In ſome fair ev'ning, on your elbow laid,
You dream of triumphs in the rural ſhade;
In penſive thought recall the fancy'd ſcene,
See coronations riſe on every green;
Before you paſs th' imaginary ſights
Of lords, and earls, and dukes, and garter'd knights,
While the ſpread fan o'er ſhades your cloſing eyes:
Then give one flirt, and all the viſion flies.
Thus vaniſh ſceptres, coronets and balls,
And leave you in lone woods or empty walls!
So when your ſlave, at ſome dear idle time,
(Not plagu'd with head-achs, or the want of rhyme)
Stands in the ſtreets, abſtracted from the crew,
And while he ſeems to ſtudy, thinks of you;
Juſt when his fancy points your ſprightly eyes,
Or ſees the bluſh of ſoft Parthenia riſe,

Gay pats my ſhoulder, and you vaniſh quite,
Streets, chairs, and coxcombs, ruſh upon my ſight?
Vex'd to be ſtill in town, I knit my brow,
Look ſour, and hum a tune, as you may now.

Sect. VII. *Of Deſcriptive Poetry.*

155 Deſcriptive poetry. Descriptive poetry is of univerſal uſe, ſince there is nothing in nature but what may be deſcribed. As poems of this kind, however, are intended more to delight than to inſtruct, great care ſhould be taken to make them agreeable. Deſcriptive poems are made beautiful by ſimiles properly introduced, images of feigned perſons, and alluſions to ancient fables or hiſtorical facts; as will appear by a peruſal of the beſt of theſe poems, eſpecially Milton's *L'Allegro* and *Il Penſeroſo*, Denham's *Cooper Hill*, and Pope's *Windſor Foreſt*. Every body being in poſſeſſion of Milton's works, we forbear inſerting the two former; and the others are too long for our purpoſe. That inimitable poem, *The Seaſons*, by Mr Thomſon, notwithſtanding ſome parts of it are didactic, may be alſo with propriety referred to this head.

Sect. VIII. *Of Allegorical Poetry.*

156 Origin of allegorical poetry. Could truth engage the affections of mankind in her native and ſimple dreſs, ſhe would require no ornament or aid from the imagination; but her delicate light, though lovely in itſelf, and dear to the moſt diſcerning, does not ſtrike the ſenſes of the multitude ſo as to ſecure their eſteem and attention: the poets therefore dreſſed her up in the manner in which they thought ſhe would appear the moſt amiable, and called in allegories and airy diſguiſes as her auxiliaries in the cauſe of virtue.

157 Its character. An allegory is a fable or ſtory, in which, under the diſguiſe of imaginary perſons or things, ſome real action or inſtructive moral is conveyed to the mind. Every allegory therefore has two ſenſes, the one literal and the other myſtical; the firſt has been aptly enough compared to a dream or viſion, of which the laſt is the true meaning or interpretation.

From this definition of allegorical poetry the reader will perceive that it gives great latitude to genius, and affords ſuch a boundleſs ſcope for invention, that the poet is allowed to ſoar beyond all creation; to give life and action to virtues, vices, paſſions, diſeaſes, and natural and moral qualities; to raiſe floating iſlands, enchanted palaces, caſtles, &c. and to people them with the creatures of his own imagination.

The poet's eye, in a fine frenzy rolling,
Doth glance from heav'n to earth, from earth to heav'n;
And, as imagination bodies forth
The forms of things unknown, the poet's pen
Turns them to ſhape, and gives to airy nothing
A local habitation and a name. Shakespeare.

But whatever is thus rais'd by the magic of his mind muſt be viſionary and typical, and the myſtical ſenſe muſt appear obvious to the reader, and inculcate ſome moral or uſeful leſſon in life; otherwiſe the whole will be deemed rather the effects of a diſtempered brain, than the productions of real wit and genius. The poet, like Jaſon, may ſail to parts unexplored, but will meet with no applauſe if he returns without a golden fleece; for theſe romantic reveries would be unpardonable but for the myſtical meaning and moral that is thus artfully and agreeably conveyed with them, and on which account only the allegory is indulged with a greater liberty than any other ſort of writing.

The ancients juſtly conſidered this ſort of allegory as the moſt eſſential part of poetry; for the power of raiſing images of things not in being, giving them a ſort of life and action, and preſenting them as it were before the eyes, was thought to have ſomething in it like creation: but then, in ſuch compoſitions, they always expected to find a meaning couched under them of conſequence; and we may reaſonably conclude, that the allegories of their poets would never have been handed down to us, had they been deficient in this reſpect.

158 Eſſentials of a juſt fable. As the *fable* is the part immediately offered to the reader's conſideration, and intended as an agreeable vehicle to convey the moral, it ought to be bold, lively, and ſurpriſing, that it may excite curioſity and ſupport attention; for if the fable be ſpiritleſs and barren of invention, the attention will be diſengaged, and the moral, however uſeful and important in itſelf, will be little regarded.

There muſt likewiſe be a juſtneſs and propriety in the fable, that is, it muſt be cloſely connected with the ſubject on which it is employed; for notwithſtanding the boundleſs compaſs allowed the imagination in theſe writings, nothing abſurd or uſeleſs is to be introduced. In epic poetry ſome things may perhaps be admitted for no other reaſon but to ſurpriſe, and to raiſe what is called the *wonderful;* which is as neceſſary to the epic as the *probable:* but in allegories, however wild and extravagant the fable and the perſons introduced, each muſt correſpond with the ſubject they are applied to, and, like the members of a well-written ſimile, bear a due proportion and relation to each other: for we are to conſider, that the allegory is a ſort of extended or rather multiplied ſimile, and therefore, like that, ſhould never loſe the ſubject it is intended to illuſtrate. Whence it will appear, that genius and fancy are here inſufficient without the aid of taſte and judgment: theſe firſt, indeed, may produce a multitude of ornaments, a wilderneſs of ſweets; but the laſt muſt be employed to accommodate them to reaſon, and to arrange them ſo as to produce pleaſure and profit.

But it is not ſufficient that the fable be correſpondent with the ſubject, and have the properties above deſcribed; for it muſt alſo be conſiſtent with itſelf. The poet may invent what ſtory he pleaſes, and form any imaginary beings that his fancy ſhall ſuggeſt; but here, as in dramatic writings, when perſons are once introduced, they muſt be ſupported to the end, and all ſpeak and act in character: for notwithſtanding the general licence here allowed, ſome order muſt be obſerved; and however wild and extravagant the characters, they ſhould not be abſurd. To this let me add, that the whole muſt be clear and intelligible; for the "fable (as Mr Hughes obſerves) being deſigned only to clothe and adorn the moral, but not to hide it, ſhould reſemble the draperies we admire in ſome of the ancient ſtatues, in which the folds are not too many nor too thick, but ſo judiciouſly ordered, that the ſhape and beauty of the limbs may be ſeen through them."— But this will more obviouſly appear from a peruſal of the beſt compoſitions of the claſs: ſuch as Spencer's Fairy Queen, Thomſon's Caſtle of Indolence, Addiſon and Johnſon's beautiful allegories in the Spectator and Rambler, &c. &c.

The word *allegory* has been uſed in a more extenſive ſenſe than that in which we have here applied it; for all writings, where the moral is conveyed under the cover of borrowed characters and actions, by which other characters and actions (that are real) are repreſented, have obtained the name of *allegories;* though the fable or ſtory contains nothing that is viſionary or romantic, but is made up of real or hiſtorical perſons, and of actions either probable or poſſible. But theſe writings ſhould undoubtedly be diſtinguiſhed by ſome other name, becauſe the literal ſenſe is conſiſtent with right reaſon, and may convey an uſeful moral, and ſatiſfy the reader, without putting him under the neceſſity of ſeeking for another.

Some of the ancient critics, as Mr Addiſon obſerves, were fond of giving the works of their poets this ſecond or concealed meaning, though there was no apparent neceſſity for the attempt, and often but little ſhow of reaſon in the application. Thus the Iliad and Odyſſey of Homer are ſaid to be fables of this kind, and that the gods and heroes introduced are only the affections of the mind repreſented in a viſible ſhape and character. They tell us, ſays he, that Achilles in the firſt Iliad repreſents anger, or the iraſcible part of human nature: that upon drawing his ſword againſt his ſuperior, in a full aſſembly, Pallas (which, ſay they, is another name for reaſon) checks and adviſes him on the occaſion, and at her firſt appearance touches him upon the head; that part of the man being looked upon as the ſeat of reaſon. In this ſenſe as Mr Hughes has well obſerved, the whole Æneis of Virgil may be ſaid to be an allegory, if you ſuppoſe Æneas to repreſent Auguſtus Cæſar, and that his conducting the remains of his countrymen from the ruins of Troy, to a new ſettlement in Italy, is an emblem of Auguſtus's forming a new government out of the ruins of the ariſtocracy, and eſtabliſhing the Romans, after the confuſion of the civil war, in a peaceable and flouriſhing condition. However ingenious this coincidence may appear, and whatever deſign Virgil had in view, he has avoided a particular and direct application, and ſo conducted his poem, that it is perfect without any allegorical interpretation; for whether we conſider Æneas or Auguſtus as the hero, the morals contained are equally inſtructive. And indeed it ſeems abſurd to ſuppoſe, that becauſe the epic poets have introduced ſome allegories into their works, every thing is to be underſtood in a myſtical manner, where the ſenſe is plain and evident without any ſuch application. Nor is the attempt that Taſſo made to turn his Jeruſalem into a myſtery, any particular recommendation of the work: for notwithſtanding he tells us, in what is called the *allegory*, printed with it, that the Chriſtian army repreſents man, the city of Jeruſalem civil happineſs, Godfrey the underſtanding, Rinaldo and Tancred the other powers of the ſoul, and that the body is typified by the common ſoldiers and the like; yet the reader will find himſelf as little delighted as edified by the explication: for the mind has little pleaſure in an allegory that cannot be opened without a key made by the hand of the ſame artiſt; and indeed every allegory that is ſo dark, and, as it were, inexplicable, loſes its very eſſence, and becomes an enigma or riddle, that is left to be interpreted by every crude imagination.

159
The ancient parable.

This laſt ſpecies of writing, whether called an *allegory*, or by any other name, is not leſs eminent and uſeful; for the introducing of real or hiſtorical perſons may not abridge or leſſen either our entertainment or inſtruction. In theſe compoſitions we often meet with an uncommon moral conveyed by the fable in a new and entertaining manner; or with a known truth ſo artfully decorated, and placed in ſuch a new and beautiful light, that we are amazed how any thing ſo charming and uſeful ſhould ſo long have eſcaped our obſervation. Such, for example, are many of Johnſon's pieces publiſhed in the Rambler under the title of *Eaſtern Stories*, and by Hawkeſworth in the Adventurer.

The ancient parables are of this ſpecies of writing: and it is to be obſerved, that thoſe in the New Teſtament have a moſt remarkable elegance and propriety; and are the moſt ſtriking, and the moſt inſtructive, for being drawn from objects that are familiar.—The more ſtriking, becauſe, as the things are ſeen, the moral conveyed becomes the object of our ſenſes, and requires little or no reflection:—the more inſtructive becauſe every time they are ſeen, the memory is awakened, and the ſame moral is again exhibited with pleaſure to the mind, and accuſtoms it to reaſon and dwell on the ſubject. So that this method of inſtruction improves nature, as it were, into a book of life; ſince every thing before us may be ſo managed, as to give leſſons for our advantage. Our Saviour's parables of the ſower and the ſeed, of the tares, of the muſtard-ſeed, and of the leaven (Matthew xiii.), are all of this kind, and were obviouſly taken from the harveſt juſt ripening before him; for *his diſciples plucked the ears of corn and did eat, rubbing them in their hands.* See the articles ALLEGORY, and METAPHOR *and Allegory*, in the general alphabet.

SECT. IX *Of Fables.*

160
The apologue or fable.

No method of inſtruction has been more ancient, more univerſal, and probably none more effectual, than that by apologue or fable. In the firſt ages, amongſt a rude and fierce people, this perhaps was the only method that would have been borne; and even ſince the progreſs of learning has furniſhed other helps, the fable, which at firſt was uſed through neceſſity, is retained from choice, on account of the elegant happineſs of its manner, and the refined addreſs with which, when well conducted, it inſinuates its moral.

As to the actors in this little drama, the fabuliſt has authority to preſs into his ſervice every kind of exiſtence under heaven; not only beaſts, birds, inſects, and all the animal creation; but flowers, ſhrubs, trees, and all the tribe of vegetables. Even mountains, foſſils, minerals, and the inanimate works of nature, diſcourſe articulately at his command, and act the part which he aſſigns them. The virtues, vices, and every property of beings, receive from him a local habitation and a name. In ſhort he may perſonify, beſtow life, ſpeech, and action, on whatever he thinks proper.

It is eaſy to imagine what a ſource of novelty and variety this muſt open to a genius capable of conceiving and of employing theſe ideal perſons in a proper manner; what an opportunity it affords him to diverſify his images, and to treat the fancy with changes of objects, while he ſtrengthens the underſtanding, or regulates the paſſions, by a ſucceſſion of truths. To raiſe beings like theſe into a ſtate of action and intelligence, gives the fabuliſt an undoubted claim to that firſt character of the poet, a *creator*.

161
Rules for its conſtruction.

When theſe perſons are once raiſed, we muſt carefully enjoin them proper taſks, and aſſign them ſentiments and language ſuitable to their ſeveral natures and reſpective properties. A raven ſhould not be extolled for her voice, nor a bear be repreſented with an elegant ſhape. It were a very obvious inſtance of abſurdity, to paint a hare cruel, or a wolf compaſſionate. An aſs were but ill qualified to be general of an army, though he may well enough ſerve, perhaps, for one of the trumpeters. But ſo long as popular opinion allows to the lion magnanimity, rage to the tiger, ſtrength to the mule, cunning to the fox, and buffoonery to the monkey; why may not they ſupport the characters of an Agamemnon, Achilles, Ajax, Ulyſſes, and Therſites? The truth is, when moral actions are with judgment attributed to the brute creation, we ſcarce perceive that nature is at all violated by the fabuliſt. He appears at moſt to have only tranſlated their language. His lions, wolves, and foxes, behave and argue as thoſe creatures would, had they originally been endowed with the human faculties of ſpeech and reaſon.

But greater art is yet required whenever we perſonify inanimate beings. Here the copy ſo far deviates from the great lines of nature, that, without the niceſt care, reaſon will revolt againſt the fiction. However, beings of this ſort, managed ingeniouſly and with addreſs, recommend the fabuliſt's invention by the grace of novelty and of variety. Indeed the analogy between things natural and artificial, animate and inanimate, is often ſo very ſtriking, that we can, with ſeeming propriety, give paſſions and ſentiments to every individual part of exiſtence. Appearance favours the deception. The vine may be enamoured of the elm; her embraces teſtify her paſſion. The ſwelling mountain may, naturally enough, be delivered of a mouſe. The gourd may reproach the pine, and the ſky rocket inſult the ſtars. The ax may ſolicit a new handle of the foreſt; and the moon, in her female character, requeſt a faſhionable garment. Here is nothing incongruous; nothing that ſhocks the reader with impropriety. On the other hand, were the ax to deſire a periwig, and the moon petition for a new pair of boots, probability would then be violated, and the abſurdity become too glaring.

162
The proper ſtyle of fable.

The moſt beautiful fables that ever were invented may be disfigured by the language in which they are clothed. Of this poor Æſop, in ſome of his Engliſh dreſſes, affords a melancholy proof. The ordinary ſtyle of fable ſhould be familiar, but alſo elegant.

The familiar, ſays Mr La Motte, is the general tone or accent of fable. It was thought ſufficient, on its firſt appearance, to lend the animals our moſt common language. Nor indeed have they any extraordinary pretenſions to the ſublime; it being requiſite they ſhould ſpeak with the ſame ſimplicity that they behave.

The familiar alſo more proper for inſinuation than the elevated; this being the language of reflection, as the former is the voice of ſentiment. We guard ourſelves againſt the one, but lie open to the other; and inſtruction will always the moſt effectually ſway us, when it appears leaſt jealous of its rights and privileges.

The familiar ſtyle, however, that is here required, notwithſtanding that appearance of eaſe which is its character, is perhaps more difficult to write than the more elevated or ſublime. A writer more readily perceives when he has riſen above the common language, than he perceives, in ſpeaking this language, whether he has made the choice that is moſt ſuitable to the occaſion: and it is, nevertheleſs, upon this happy choice that all the charms of the familiar depend. Moreover, the elevated ſtyle deceives and ſeduces, although it be not the beſt choſen; whereas the familiar can procure itſelf no ſort of reſpect, if it be not eaſy, natural, juſt, delicate, and unaffected. A fabuliſt muſt therefore beſtow great attention upon his ſtyle; and even labour it ſo much the more that it may appear to have coſt him no pains at all.

The authority of Fontaine juſtifies theſe opinions in regard to ſtyle. His fables are perhaps the beſt examples of the genteel familiar, as Sir Roger L'Eſtrange affords the groſſeſt of the indelicate and low. When we read that "while the frog and the mouſe were diſputing it at ſwords-point, down comes a kite powdering upon them in the interim, and gobbets up both together to part the fray;" and "where the fox reproaches a bevy of jolly goſſipping wenches making merry over a diſh of pullets, that if he but peeped into a hen-rooſt, they always made a bawling with their dogs and their baſtards; while you yourſelves (ſays he) can lie ſtuffing your guts with your hens and capons, and not a word of the pudding:" This may be familiar; but it is alſo coarſe and vulgar, and cannot fail to diſguſt a reader that has the leaſt degree of taſte or delicacy.

The ſtyle of fable then muſt be ſimple and familiar; and it muſt likewiſe be correct and elegant. By the former, we mean, that it ſhould not be loaded with figure and metaphor; that the diſpoſition of words be natural, the turn of ſentences eaſy, and their conſtruction unembarraſſed. By elegance, we would exclude all coarſe and provincial terms; all affected and puerile conceits; all obſolete and pedantic phraſes. To this we we would adjoin, as the word perhaps implies, a certain finiſhing poliſh, which gives a grace and ſpirit to the whole; and which, though it have always the appearance of nature, is almoſt ever the effect of art.

But notwithſtanding all that has been ſaid, there are ſome occaſions on which it is allowable, and even expedient, to change the ſtyle. The language of a fable muſt riſe or fall in conformity to the ſubject. A lion when introduced in his regal capacity, muſt hold diſcourſe in a ſtrain ſomewhat more elevated than a country mouſe. The lioneſs then becomes his queen, and the beaſts of the foreſt are called his ſubjects: a method that offers at once to the imagination both the animal and the perſon he is deſigned to repreſent. Again, the buffoon-monkey ſhould avoid that pomp of phraſe, which the owl employs as her beſt pretence to wiſdom,

wiſdom. Unleſs the ſtyle be thus judiciouſly varied, it will be impoſſible to preſerve a juſt diſtinction of character.

Deſcriptions, at once conciſe and pertinent, add a grace to fable; but are then moſt happy when included in the action: whereof the fable of Boreas and the Sun affords us an example. An epithet well choſen is often a deſcription in itſelf; and ſo much the more agreeable, as it the leſs retards us in our purſuit of the cataſtrophe.

Laſtly, little ſtrokes of humour when ariſing naturally from the ſubject, and incidental reflections when kept in due ſubordination to the principal, add a value to theſe compoſitions. Theſe latter, however, ſhould be employed very ſparingly, and with great addreſs; be very few, and very ſhort: it is ſcarcely enough that they naturally ſpring out of the ſubject; they ſhould be ſuch as to appear neceſſary and eſſential parts of the fable. And when theſe embelliſhments, pleaſing in themſelves, tend to illuſtrate the main action, they then afford that nameleſs grace remarkable in Fontaine and ſome few others, and which perſons of the beſt diſcernment will more eaſily conceive than they can explain.

Sect. X. *Of Satire.*

163 Origin of Satire.

This kind of poem is of very ancient date, and (if we believe Horace) was introduced, by way of interlude, by the Greek dramatic poets in their tragedies, to relieve the audience, and take off the force of thoſe ſtrokes which they thought too deep and affecting. In thoſe ſatirical interludes, the ſcene was laid in the country; and the perſons were rural deities, ſatyrs, country peaſants, and other ruſtics.

> The firſt Tragedians found that ſerious ſtyle
> Too grave for their uncultivated age,
> And ſo brought wild and naked Satyrs in
> (Whoſe motion, words, and ſhape, were all a farce)
> As oft as decency would give them leave;
> Becauſe the mad, ungovernable rout,
> Full of confuſion and the fumes of wine,
> Lov'd ſuch variety and antic tricks.
>
> Roſcommon's *Horace*.

The ſatire we now have is generally allowed to be of Roman invention. It was firſt introduced without the decorations of ſcenes and action; but written in verſes of different meaſures by Ennius, and afterwards moulded into the form we now have it by Lucilius, whom Horace has imitated, and mentions with eſteem. This is the opinion of moſt of the critics, and particularly of Boileau, who ſays,

> Lucilius led the way, and, bravely bold,
> To Roman vices did the mirror hold;
> Protected humble goodneſs from reproach,
> Show'd worth on foot, and raſcals in a coach.
> Horace his pleaſing wit to this did add,
> That none, uncenſur'd, might be fools or mad:
> And Juvenal, with rhetorician's rage,
> Scourg'd the rank vices of a wicked age;
> Tho' horrid truths thro' all his labours ſhine,
> In what he writes there's ſomething of divine.

Our ſatire, therefore, may be diſtinguiſhed into two kinds; the *jocoſe*, or that which makes ſport with vice and folly, and ſets them up to ridicule; and the *ſerious*, or that which deals in aſperity, and is ſevere and acrimonious. Horace is a perfect maſter of the firſt and Juvenal much admired for the laſt. The one is facetious, and ſmiles: the other is angry, and ſtorms. The foibles of mankind are the object of one; but crimes of a deeper dye have engaged the other. They both agree, however, in being pungent and biting: and from a due conſideration of the writings of theſe authors, who are our maſters in this art, we may define ſatire to be, A free, (and often jocoſe), witty, and ſharp poem, wherein the follies and vices of men are laſhed and ridiculed in order to their reformation. Its ſubject is whatever deſerves our contempt or abhorrence, (including every thing that is ridiculous and abſurd, or ſcandalous and repugnant to the golden precepts of religion and virtue.) Its manner is *invective*; and its end, *ſhame*. So that ſatire may be looked upon as the phyſician of a diſtempered mind, which it endeavours to cure by bitter and unſavoury, or by pleaſant and ſalutary, applications.

164 Definition of it.

165 Qualities of a good ſatiriſt.

A good ſatiriſt ought to be a man of wit and addreſs, ſagacity and eloquence. He ſhould alſo have a great deal of good-nature, as all the ſentiments which are beautiful in this way of writing muſt proceed from that quality in the author. It is good-nature produces that diſdain of all baſeneſs, vice, and folly, which prompts the poet to expreſs himſelf with ſuch ſmartneſs againſt the errors of men, but without bitterneſs to their perſons. It is this quality that keeps the mind even, and never lets an offence unſeaſonably throw the ſatiriſt out of his character.

In writing ſatire, care ſhould be taken that it be true and general; that is, levelled at abuſes in which numbers are concerned: for the perſonal kind of ſatire, or lampoon, which expoſes particular characters, and affects the reputation of thoſe at whom it is pointed, is ſcarce to be diſtinguiſhed from ſcandal and defamation. The poet alſo, whilſt he is endeavouring to correct the guilty, muſt take care not to uſe ſuch expreſſions as may corrupt the innocent: he muſt therefore avoid all obſcene words and images that tend to debaſe and miſlead the mind. Horace and Juvenal, the chief ſatiriſts among the Romans, are faulty in this reſpect, and ought to be read with caution.

166 Proper ſtyle of ſatire.

The ſtyle proper for ſatire is ſometimes grave and animated, inveighing againſt vice with warmth and earneſtneſs; but that which is pleaſant, ſportive, and, with becoming raillery, banters men out of their bad diſpoſitions, has generally the beſt effect, as it ſeems only to play with their follies, though it omits no opportunity of making them feel the laſh. The verſes ſhould be ſmooth and flowing, and the language manly, juſt, and decent.

> Of well-choſe words ſome take not care enough,
> And think they ſhould be as the ſubject rough:
> But ſatire muſt be more exactly made,
> And ſharpeſt thoughts in ſmootheſt words convey'd.
>
> Duke of *Bucks's* Essay.

Satires, either of the *jocoſe* or *ſerious* kind, may be written in the epiſtolary manner, or by way of dialogue. Horace, Juvenal, and Perſius, have given us examples of both. Nay, ſome of Horace's ſatires may, without incongruity, be called *epiſtles*, and his epiſtles *ſatires*. But this is obvious to every reader.

Of the facetious kind, the ſecond ſatire of the ſecond book of Horace imitated by Mr Pope, and Swift's verſes on his own death, may be referred to as examples.

As to thoſe ſatires of the ſerious kind, for which Juvenal is ſo much diſtinguiſhed, the characteriſtic properties of which are, morality, dignity, and ſeverity; a better example cannot be mentioned than the poem entitled *London* written in imitation of the third ſatire of Juvenal, by Dr Johnſon, who has kept up to the ſpirit and force of the original.

Nor muſt we omit to mention Dr Young's *Love of Fame the Univerſal Paſſion*, in ſeven ſatires; which, though characteriſtical, abound with morality and good ſenſe. The characters are well ſelected, the ridicule is high, and the ſatire well pointed and to the purpoſe.

We have already obſerved, that perſonal ſatire approaches too near defamation, to deſerve any countenance or encouragement. Dryden's *Mack Flecknoe* is for this reaſon exceptionable, but as a compoſition it is inimitable.

167 Benefits of well-conducted ſatire.

We have dwelt thus long on the preſent ſubject, becauſe there is reaſon to apprehend, that the benefits ariſing from well-conducted ſatire have not been ſufficiently conſidered. A ſatire may often do more ſervice to the cauſe of religion and virtue than a ſermon; ſince it gives pleaſure, at the ſame time that it creates fear or indignation, and conveys its ſentiments in a manner the moſt likely to captivate the mind.

> Of all the ways that wiſeſt men could find
> To mend the age and mortify mankind,
> Satire well writ has moſt ſucceſsful prov'd,
> And cures, becauſe the remedy is lov'd.
> Duke of *Bucks's Essay*.

But to produce the deſired effect, it muſt be jocoſe, free, and impartial, though ſevere. The ſatiriſt ſhould always preſerve good-humour; and, however keen he cuts, ſhould cut with kindneſs. When he loſes temper, his weapons will be inverted, and the ridicule he threw at others will retort with contempt upon himſelf: for the reader will perceive that he is angry and hurt, and conſider his ſatire as the effect of malice, not of judgement; and that it is intended rather to wound perſons than reform manners

> Rage you muſt hide, and prejudice lay down:
> A ſatyr's ſmile is ſharper than his frown.

The beſt, and indeed the only, method to expoſe vice and folly effectually, is to turn them to ridicule, and hold them up for public contempt; and as it moſt offends theſe objects of ſatire, ſo it leaſt hurts ourſelves. One paſſion frequently drives out another; and as we cannot look with indifference on the bad actions of men (for they muſt excite either our wrath or contempt), it is prudent to give way to that which moſt offends vice and folly, and leaſts affects ourſelves; and to ſneer and laugh, rather than be angry and ſcold.

168 Burleſque poetry.—Splendid Shilling.—Hudibras.

Burleſque poetry, which is chiefly uſed by way of drollery and ridicule, falls properly to be ſpoken of under the head of ſatire. An excellent example of this kind is a poem in blank verſe, intitled *The Splendid Shilling*, written by Mr John Philips, which, in the opinion of one of the beſt judges of the age, is the fineſt burleſque in the Engliſh language. In this poem the author has handled a low ſubject in the lofty ſtyle and numbers of Milton; in which way of writing Mr Philips has been imitated by ſeveral, but none have come up to the humour and happy turn of the original. When we read it, we are betrayed into a pleaſure that we could not expect; though, at the ſame time, the ſublimity of the ſtyle, and gravity of the phraſe, ſeem to chaſtiſe that laughter which they provoke.

There is another ſort of verſe and ſtyle, which is moſt frequently made uſe of in treating any ſubject in a ludicrous manner, viz. that which is generally called *Hudibraſtic*, from Butler's admirable poem entitled *Hudibras*. Almoſt every one knows, that this poem is a ſatire upon the authors of the civil diſſenſions in the reign of king Charles I. wherein the poet has, with abundance of wit and humour, expoſed and ridiculed the hypocriſy or blind zeal of thoſe unhappy times. In ſhort, it is a kind of burleſque epic poem, which for the oddity of the rhymes, the quaintneſs of the ſimilies, the novelty of the thoughts, and that fine raillery which runs through the whole performance, is not to be paralleled.

SECT. XI. *Of the Epigram.*

169 Character of the epigram.

THE *Epigram is a little poem, or compoſition in verſe, treating of one thing only, and whoſe diſtinguiſhing characters are* brevity, beauty, and point.

The word *epigram* ſignifies "inſcription;" for epigrams derive their origin from thoſe inſcriptions placed by the ancients on their ſtatues, temples, pillars, triumphal arches, and the like; which, at firſt, were very ſhort, being ſometimes no more than a ſingle word; but afterwards, increaſing their length, they made them in verſe, to be the better retained by the memory. This ſhort way of writing came at laſt to be uſed upon any occaſion or ſubject; and hence the name of *epigram* has been given to any little copy of verſes, without regard to the original application of ſuch poems.

Its uſual limits are from two to 20 verſes, though ſometimes it extends to 50; but the ſhorter, the better it is, and the more perfect, as it partakes more of the nature and character of this kind of poem: beſides, the epigram, being only a ſingle thought, ought to be expreſſed in a little compaſs, or elſe it loſes its force and ſtrength.

The beauty required in an epigram is an harmony and apt agreement of all its parts, a ſweet ſimplicity, and polite language.

The point is a ſharp, lively, unexpected turn of wit, with which an epigram ought to be concluded. There are ſome critics, indeed, who will not admit the point in an epigram; but require that the thought be equally diffuſed through the whole poem, which is uſually the practice of Catullus, as the former is that of Martial. It is allowed there is more delicacy in the manner of Catullus; but the point is more agreeable to the general taſte, and ſeems to be the chief characteriſtic of the epigram.

170 Of what ſubjects it admits.

This ſort of poem admits of all manner of ſubjects, provided that brevity, beauty, and point, are preſerved;

ved; but it is generally employed either in praiſe or ſatire.

Though the beſt epigrams are ſaid to be ſuch as are compriſed in two or four verſes, we are not to underſtand it as if none can be perfect which exceed thoſe limits. Neither the ancients nor moderns have been ſo ſcrupulous with reſpect to the length of their epigrams; but, however, brevity in general is always to be ſtudied in theſe compoſitions.

171 Examples of Engliſh epigrams remarkable for their delicacy, and

For examples of good epigrams in the Engliſh language, we ſhall make choice of ſeveral in the different taſtes we have mentioned; ſome remarkable for their delicate turn and ſimplicity of expreſſion; and others for their ſalt and ſharpneſs, their equivocating pun, or pleaſant alluſion. In the firſt place, take that of Mr Pope, ſaid to be written on a glaſs with the earl of Cheſterfield's diamond pencil.

Accept a miracle, inſtead of wit;
See two dull lines by Stanhope's pencil writ.

The beauty of this epigram is more eaſily ſeen than deſcribed; and it is difficult to determine, whether it does more honour to the poet who wrote it, or to the nobleman for whom the compliment is deſigned.—The following epigram of Mr Prior is written in the ſame taſte, being a fine encomium on the performance of an excellent painter.

On a flower painted by VARELST.

When fam'd Vareſt this little wonder drew,
Flora vouchſaf'd the growing work to view:
Finding the painter's ſcience at a ſtand,
The goddeſs ſnatch'd the pencil from his hand,
And, finiſhing the piece, ſhe ſmiling ſaid,
Behold one work of mine which ne'er ſhall fade.

Another compliment of this delicate kind he has made Mr Howard in the following epigram.

VENUS *Miſtaken.*

When Chloe's picture was to Venus ſhown;
Surpris'd, the goddeſs took it for her own.
And what, ſaid ſhe, does this bold painter mean?
When was I bathing thus, and naked ſeen?
Pleas'd Cupid heard, and check'd his mother's pride:
And who's blind now, mamma? the urchin cry'd.
'Tis Chloe's eye, and cheek, and lip, and breaſt:
Friend Howard's genius fancy'd all the reſt.

Moſt of Mr Prior's epigrams are of this delicate caſt, and have the thought, like thoſe of Catullus, diffuſed through the whole. Of this kind is his addreſs

To CHLOE *Weeping.*

See whilſt thou weep'ſt, fair Chloe, ſee
The world in ſympathy with thee.
The cheerful birds no longer ſing,
Each drops his head, and hangs his wing.
The clouds have bent their boſom lower,
And ſhed their ſorrow in a ſhow'r.
The brooks beyond their limits flow,
And louder murmurs ſpeak their wo:
The nymphs and ſwains adopt thy cares;
They heave thy ſighs, and weep thy tears.
Fantaſtic nymph! that grief ſhould move
Thy heart obdurate againſt love.
Strange tears! whoſe pow'r can ſoften all
But that dear breaſt on which they fall.

The epigram written on the leaves of a fan by Dr Atterbury, late biſhop of Rocheſter, contains a pretty thought, expreſſed with eaſe and conciſeneſs, and cloſed in a beautiful manner.

On a FAN.

Flavia the leaſt and ſlighteſt toy
Can with reſiſtleſs art employ.
This fan in meaner hands would prove
An engine of ſmall force in love:
Yet ſhe, with graceful air and mien,
Not to be told or ſafely ſeen,
Directs its wanton motion ſo,
That it wounds more than Cupid's bow,
Gives coolneſs to the matchleſs dame,
To every other breaſt a flame.

172 For their point.

We ſhall now ſelect ſome epigrams of the biting and ſatirical kind, and ſuch as turn upon the *pun* or *equivoque*, as the French call it; in which ſort the point is more conſpicuous than in thoſe of the former character.

The following diſtich is an admirable epigram, having all the neceſſary qualities of one, eſpecially point and brevity.

On a Company of bad DANCERS *to good Muſic.*

How ill the motion with the muſic ſuits!
So Orpheus fiddled, and ſo danc'd the brutes.

This brings to mind another epigram upon a bad fiddler, which we ſhall venture to inſert merely for the humour of it, and not for any real excellence it contains.

To a bad FIDDLER.

Old Orpheus play'd ſo well, he mov'd Old Nick;
But thou mov'ſt nothing but thy fiddle-ſtick.

One of Martial's epigrams, wherein he agreeably rallies the fooliſh vanity of a man who hired people to make verſes for him, and publiſhed them as his own, has been thus tranſlated into Engliſh:

Paul, ſo fond of the name of a poet is grown,
With gold he buys verſes, and calls them his own.
Go on, maſter Paul, nor mind what the world ſays,
They are ſurely his own for which a man pays.

Some bad writer having taken the liberty to cenſure Mr Prior, the poet very wittily laſhed his impertinence in this epigram:

While faſter than his coſtive brain indites,
Philo's quick hand in flowing letters writes,
His caſe appears to me like honeſt Teague's,
When he was run away with by his legs.
Phœbus, give Philo o'er himſelf command;
Quicken his ſenſes, or reſtrain his hand:
Let him be kept from paper, pen, and ink;
So he may ceaſe to write, and learn to think.

Mr Weſley has given us a pretty epigram, alluding to a well known text of ſcripture, on the ſetting up a monument in Weſtminſter Abbey, to the memory of the ingenious Mr Butler, author of *Hudibras*.

While Butler, needy wretch, was yet alive,
No generous patron would a dinner give.
See him when ſtarv'd to death, and turn'd to duſt,
Preſented with a monumental buſt!
The poet's fate is here in emblem ſhown;
He aſk'd for *Bread*, and he receiv'd a *Stone*.

We ſhall cloſe this ſection with an epigram written on the well known ſtory of Apollo and Daphne, by Mr Smart.

When Phœbus was am'rous and long'd to be rude,
Miſs Daphne cry'd Piſh! and ran ſwiſt to the wood;
And rather than do ſuch a naughty affair,
She became a fine laurel to deck the god's hair.
The nymph was, no doubt, of cold conſtitution;
For, ſure, to turn tree was an odd reſolution!
Yet in this ſhe behav'd like a true modern ſpouſe,
For ſhe fled from his arms to diſtinguiſh his brows.

SECT. XII. *Of the Epitaph.*

173 Character of the epitaph.

THESE compoſitions generally contain ſome eulogium of the virtues and good qualities of the deceaſed, and have a turn of ſeriouſneſs and gravity adapted to the nature of the ſubject. Their elegance conſiſts in a nervous and expreſſive brevity; and ſometimes they are cloſed with an epigrammatic point. In theſe compoſitions, no mere epithet (properly ſo called) ſhould be admitted; for here illuſtration would impair the ſtrength, and render the ſentiment too diffuſe and languid. Words that are ſynonymous are alſo to be rejected.

Though the true characteriſtic of the epitaph is ſeriouſneſs and gravity, yet we may find many that are jocoſe and ludicrous: ſome likewiſe have true metre and rhyme; while others are between proſe and verſe, without any certain meaſure, though the words are truly poetical; and the beauty of this laſt ſort is generally heightened by an apt and judicious antitheſis We ſhall give examples of each.

The following epitaph on Sir Philip Sydney's ſiſter, the counteſs of Pembroke, ſaid to be written by the famous Ben Jonſon, is remarkable for the noble thought with which it concludes.

174 Epitaphs in verſe, with remarks upon them.

On MARY *Counteſs-dowager of* PEMBROKE.

Underneath this noble marble hearſe,
Lies the ſubject of all verſe,
Sidney's ſiſter, Pembroke's mother:
Death, ere thou haſt kill'd another
Fair, and learn'd, and good as ſhe,
Time ſhall throw a dart at thee.

Take another epitaph of Ben Jonſon's, on a beautiful and virtuous lady, which has been deſervedly admired by very good judges.

Underneath this ſtone doth lie
As much virtue as could die;
Which when alive did vigour give
To as much beauty as could live.

The following epitaph by Dr Samuel Johnſon, on a muſician much celebrated for his performance, will bear a compariſon with theſe, or perhaps with any thing of the kind in the Engliſh language.

Philips! whoſe touch harmonious could remove
The pangs of guilty pow'r and hapleſs love,
Reſt here, diſtreſt by poverty no more;
Find here that calm thou gav'ſt ſo oft before;
Sleep undiſturb'd within this peaceful ſhrine,
Till angels wake thee with a note like thine.

It is the juſt obſervation of an eminent critic, that the beſt ſubject for epitaphs is private virtue; virtue exerted in the ſame circumſtances in which the bulk of mankind are placed, and which, therefore, may admit of many imitators. He that has delivered his country from oppreſſion, or freed the world from ignorance and error, beſides that he ſtands in no need of monumental panegyric, can excite the emulation of a very ſmall number. The bare name of ſuch men anſwers every purpoſe of a long inſcription, becauſe their atchievements are univerſally known, and their fame is immortal.—But the virtues of him who has repelled the temptations of poverty, and diſdained to free himſelf from diſtreſs at the expence of his honour or his conſcience, as they were practiſed in private, are fit to be told, becauſe they may animate multitudes to the ſame firmneſs of heart and ſteadineſs of reſolution. On this account, there are few epitaphs of more value than the following, which was written by Pope on Mrs Corbet, who died of a cancer in her breaſt.

Here reſts a woman, good without pretence,
Bleſt with plain reaſon, and with ſober ſenſe:
No conqueſt ſhe, but o'er herſelf deſir'd;
No arts eſſay'd, but not to be admir'd.
Paſſion and pride were to her ſoul unknown,
Convinc'd that virtue only is our own.
So unaffected, ſo compos'd a mind,
So firm, yet ſoft, ſo ſtrong, yet ſo refin'd,
Heav'n, as its pureſt gold, by tortures try'd;
The ſaint ſuſtain'd it, but the woman dy'd.

This epitaph, as well as the ſecond quoted from Ben Jonſon, has indeed one fault: the name is omitted. The end of an epitaph is to convey ſome account of the dead; and to what purpoſe is any thing told of him whoſe name is concealed? The name, it is true, may be inſcribed by itſelf upon the ſtone; but ſuch a ſhift of the poet is like that of an unſkilful painter, who is obliged to make his purpoſe known by adventitious help.

Amongſt the epitaphs of a punning and ludicrous caſt, we know of none prettier than that which is ſaid to have been written by Mr Prior on himſelf, wherein he is pleaſantly ſatirical upon the folly of thoſe who value themſelves upon account of the long ſeries of anceſtors through which they can trace their pedigree.

Nobles and heralds, by your leave,
Here lie the bones of Matthew Prior,
The ſon of Adam and of Eve:
Let Bourbon or Naſſau go higher.

The following epitaph on a miſer contains a good caution and an agreeable raillery.

Reader, beware immoderate love of pelf:
Here lies the worſt of thieves, who robb'd himſelf.

But Dr Swift's epitaph on the ſame ſubject is a maſterpiece of the kind.

Beneath

Epitaph.

Beneath this verdant hillock lies
Demer, the wealthy and the wiſe.
His heirs, that he might ſafely reſt,
Have put his carcaſe in a cheſt:
The very cheſt, in which, they ſay,
His other Self, his money, lay.
And if his heirs continue kind
To that dear ſelf he left behind,
I dare believe that four in five
Will think his better half alive.

We ſhall give but one example more of this kind, which is a merry epitaph on an old fiddler, who was remarkable (we may ſuppoſe) for beating time to his own muſic.

On Stephen the Fiddler.

Stephen and time are now both even;
Stephen beat time, now time's beat Stephen.

175 Epitaphs in proſe encomiaſtic and

We are come now to that ſort of epitaph which rejects rhyme, and has no certain and determinate meaſure; but where the diction muſt be pure and ſtrong, every word have weight, and the antitheſis be preſerved in a clear and direct oppoſition. We cannot give a better example of this ſort of epitaph than that on the tomb of Mr Pulteney in the cloiſters of Weſtminſter-abbey.

Reader,
If thou art a Briton,
Behold this Tomb with Reverence and Regret:
Here lie the Remains of
Daniel Pulteney,
The kindeſt Relation, the trueſt Friend,
The warmeſt Pariot, the worthieſt Man.
He exerciſed Virtues in this Age,
Sufficient to have diſtinguiſh'd him even in the beſt.
Sagacious by Nature,
Induſtrious by Habit,
Inquiſitive with Art;
He gain'd a complete Knowledge of the State of Britain,
Foreign and Domeſtic;
In moſt the backward Fruit of tedious Experience,
In him the early acquiſition of undiſſipated Youth.
He ſerv'd the Court ſeveral Years:
Abroad, in the auſpicious Reign of Queen Anne;
At home, in the Reign of that excellent prince K. George I.
He ſerved his Country always,
At Court independent,
In the Senate unbias'd,
At every Age, and in every Station:
This was the bent of his generous Soul,
This the buſineſs of his laborious Life.
Public Men, and Public Things,
He judged by one conſtant Standard,
The True Intereſt of Britian:
He made no other Diſtinction of Party,
He abhorred all other.
Gentle, humane, diſintereſted, beneficent,
He created no Enemies on his own Account:
Firm, determin'd, inflexible,
He feared none he could create in the Cauſe of Britain.
Reader,
In this Miſfortune of thy Country lament thy own:
For Know,
The Loſs of ſo much private Virtue
Is a public calamity.

Epitaph. 176 Satirical.

That poignant ſatire, as well as extravagant praiſe, may be conveyed in this manner, will be ſeen by the following epitaph written by Dr Arbuthnot on Francis Chartres; which is too well known, and too much admired, to need our commendation.

Here continueth to rot
The Body of FRANCIS CHARTRES,
Who with an Inflexible Constancy,
And inimitable Uniformity of Life,
Persisted,
In ſpite of Age and Infirmities,
In the Practice of every Human Vice,
Excepting Prodigality and Hypocrisy:
His inſatiable Avarice exempted him from the firſt,
His matchleſs Impudence from the ſecond.
Nor was he more ſingular
In the undeviating *Pravity* of his *Manners*,
Than ſucceſsful
In *Accumulating* Wealth:
For, without Trade or Profession,
Without Trust of Public Money,
And without Bribe-worthy Service,
He acquired, or more properly created,
A Ministerial Estate.
He was the only perſon of his Time
Who could cheat without the Maſk of Honesty
Retain his Primæval Meanness
When poſſeſſed of Ten Thousand a-year;
And having daily deſerved the Gibbet for what he *did*,
Was at laſt condemn'd to it for what he *could* not *do*.
Oh indignant reader!
Think not his Life uſeleſs to mankind;
Providence conniv'd at his execrable deſigns,
To give to After-ages
A conſpicuous Proof and Example
Of how ſmall eſtimation is Exorbitant Wealth
In the Sight of GOD,
By His beſtowing it on the moſt Unworthy of all
Mortals.

We ſhall conclude this ſpecies of poetry with a droll and ſatirical epitaph written by Mr Pope, which we tranſcribe from a monument in Lord Cobham's gardens at Stow in Buckinghamſhire.

To the Memory
of
Signior Fido,
An *Italian* of good extraction;
Who came into *England*,
Not to bite us, like moſt of his Countrymen,
But to gain an honeſt Livelihood.
He hunted not after Fame,
Yet acquir'd it;
Regardleſs of the Praiſe of his Friends,
But moſt ſenſible of their Love,
Though he liv'd amongſt the Great,
He neither learnt nor flatter'd any Vice.
He was no Bigot,
Though he doubted of none of the 39 Articles.
And, if to follow Nature,
And to reſpect the laws of Society,
Be Philoſophy,
He was a perfect Philoſopher,
A faithful Friend,
An agreeable Companion,

A loving Huſband,
Diſtinguiſh'd by a numerous offſpring,
All which he liv'd to ſee take good Courſes.
In his old age he retired
To the houſe of a Clergyman in the country,
Where he finiſhed his earthly Race,
And died an Honour and an example to the whole Species.

Reader,
This Stone is guiltleſs of Flattery;
For he to whom it is inſcrib'd
Was not a MAN,
But a
GREY-HOUND.

PART III. ON VERSIFICATION.

ON this ſubject it is meant to confine our inquiry to Latin or Greek hexameters, and to French and Engliſh heroic verſe; as the obſervations we ſhall have occaſion to make, may, with proper variations, be eaſily transferred to the compoſition of other ſorts of verſe.

177 Eſſentials of verſe.

178 Regulation of pauſes.

Before entering upon particulars, it muſt be premiſed in general, that to verſe of every kind five things are of importance. 1ſt, The number of ſyllables that compoſe a line. 2d, The different lengths of ſyllables, *i. e.* the difference of time taken in pronouncing. 3d, The arrangement of theſe ſyllables combined in words. 4th, The pauſes or ſtops in pronouncing. 5th, Pronouncing ſyllables in a high or low tone. The three firſt mentioned are obviouſly eſſential to verſe: if any of them be wanting, there cannot be that higher degree of melody which diſtinguiſheth verſe from proſe. To give a juſt notion of the fourth, it muſt be obſerved, that pauſes are neceſſary for three different purpoſes: one, to ſeparate periods, and members of the ſame period, according to the ſenſe: another, to improve the melody of verſe: and the laſt, to afford opportunity for drawing breath in reading. A pauſe of the firſt kind is variable, being long or ſhort, frequent or leſs frequent, as the ſenſe requires. A pauſe of the ſecond kind, being determined by the melody, is in no degree arbitrary. The laſt ſort is in a meaſure arbitrary, depending on the reader's command of breath. But as one cannot read with grace, unleſs, for drawing breath, opportunity be taken of a pauſe in the ſenſe or in the melody, this pauſe ought never to be diſtinguiſhed from the others; and for that reaſon ſhall be laid aſide. With reſpect then to the pauſes of ſenſe and of melody, it may be affirmed without heſitation, that their coincidence in verſe is a capital beauty: but as it cannot be expected, in a long work eſpecially, that every line ſhould be ſo perfect; we ſhall afterward have occaſion to ſee, that, unleſs the reader be uncommonly ſkilful, the pauſe neceſſary for the ſenſe muſt often, in ſome degree, be ſacrificed to the verſe-pauſe, and the latter ſometimes to the former.

The pronouncing ſyllables in a high or low tone contributes alſo to melody. In reading, whether verſe or proſe, a certain tone is aſſumed, which may be called the *key-note*; and in that tone the bulk of the words are ſounded. Sometimes to humour the ſenſe, and ſometimes the melody, a particular ſyllable is ſounded in a higher tone, and this is termed *accenting a ſyllable*, or gracing it with an accent. Oppoſed to the accent is the cadence, which, however, being entirely regulated by the ſenſe, hath no peculiar relation to verſe. The cadence is a falling of the voice below the key-note at the cloſe of every period; and ſo little is it eſſential to verſe, that in correct reading the final ſyllable of every line is accented, that ſyllable only excepted which cloſes the period, where the ſenſe requires a cadence.

179 Quantity.

Though the five requiſites above mentioned enter the compoſition of every ſpecies of verſe, they are however governed by different rules, peculiar to each ſpecies. Upon quantity only, one general obſervation may be premiſed, becauſe it is applicable to every ſpecies of verſe. That ſyllables, with reſpect to the time taken in pronouncing, are long or ſhort; two ſhort ſyllables, with reſpect to time, being preciſely equal to a long one. Theſe two lengths are eſſential to verſe of all kinds; and to no verſe, it is believed, is a greater variety of time neceſſary in pronouncing ſyllables. The voice indeed is frequently made to reſt longer than uſual upon a word that bears an important ſignification; but this is done to humour the ſenſe, and is not neceſſary for melody. A thing not more neceſſary for melody occurs with reſpect to accenting, ſimilar to that now mentioned: a word ſignifying any thing humble, low, or dejected, is naturally, in proſe as well as in verſe, pronounced in a tone below the key-note.

We are now ſufficiently prepared for particulars; beginning with Latin or Greek hexameter, which are the ſame. The obſervations upon this ſpecies of verſe will come under the four following heads; number, arrangement, pauſe, and accent; for as to quantity, what is obſerved above may ſuffice.

180 Hexameter verſes of the Greeks and Romans conſiſt of what feet.

I. HEXAMETER LINES, as to time, are all of the ſame length; being equivalent to the time taken in pronouncing twelve long ſyllables or twenty-four ſhort. An hexameter line may conſiſt of ſeventeen ſyllables; and when regular and not ſpondaic it never has fewer than thirteen: whence it follows, that where the ſyllables are many, the plurality muſt be ſhort; where few, the plurality muſt be long.

This line is ſuſceptible of much variety as to the ſucceſſion of long and ſhort ſyllables. It is, however, ſubjected to laws that confine its variety within certain limits: and for aſcertaining theſe limits, grammarians have invented a rule by dactyles and ſpondees, which they denominate *feet*.

Among the ancient Greeks and Romans, theſe feet regulated the pronunciation, which they are far from doing among us; of which the reaſon will be diſcovered from the explanation that we ſhall give of the Engliſh accent. We ſhall at preſent content ourſelves with pointing out the difference between our pronunciation and that of the Romans in the firſt line of Virgil's eclogues, where it is ſcarcely credible how much we pervert the quantity.

Tit'yre tú pat'ulæ rec'ubans ſub teg'mine fági.

It will be acknowledged by every reader who has an ear, that we have placed the accentual marks upon every ſyllable, and the letter of every ſyllable, that an Engliſhman marks with the *ictus* of his voice when he recites the line. But, as will be ſeen preſently, a ſyllable which is pronounced with the ſtreſs of the voice upon a conſonant is uttered in the ſhorteſt time poſſible. Hence it follows, that in this verſe, as recited by us, there are but two long ſyllables, *tú* and *ſá;* though it is certain, that, as recited by a Roman, it contained no fewer than eight long ſyllables.

Tītўrĕ | tŭ pătŭ|lāē rĕcŭ|bāns ſūb | tĕgmĭnĕ | fāgī.

But though to pronounce it in this manner with the voice dwelling on the vowel of each long ſyllable would undoubtedly be correct, and preſerve the true movement of the verſe, yet to an Engliſh ear, prejudiced in behalf of a different movement, it ſounds ſo very uncouth, that Lord Kames has pronounced the true feet of the Greek and Roman verſes extremely artificial and complex; and has ſubſtituted in their ſtead the following rules, which he thinks more ſimple and of more eaſy application. 1ſt, The line muſt always commence with a long ſyllable, and cloſe with two long preceded by two ſhort. 2d, More than two ſhort can never be found together, nor fewer than two. And, 3d, Two long ſyllables which have been preceded by two ſhort cannot alſo be followed by two ſhort. Theſe few rules fulfil all the conditions of an hexameter line with relation to order or arrangement. For theſe again a ſingle rule may be ſubſtituted, which has alſo the advantage of regulating more affirmatively the conſtruction of every part. To put this rule into words with perſpicuity, a hint is taken from the twelve long ſyllables that compoſe an hexameter line, to divide it into twelve equal parts or portions, being each of them one long ſyllable or two ſhort. The rule then is: "The 1ſt, 3d, 5th, 7th, 9th, 11th, and 12th portions, muſt each of them be one long ſyllable; the 10th muſt always be two ſhort ſyllables; the 2d, 4th, 6th, and 8th, may either be one long or two ſhort." Or to expreſs the thing ſtill more ſhortly, "The 2d, 4th, 5th, and 6th portions may be one long ſyllable or two ſhort; the 10th muſt be two ſhort ſyllables; all the reſt muſt conſiſt each of one long ſyllable." This fulfils all the conditions of an hexameter line, and comprehends all the combinations of dactyles and ſpondees that this line admits.

Elem. of Criticiſm, ch. xviii. ſect. 4.

181 Pauſes in hexameter conſidered with reſpect to melody and

Next in order comes the pauſe. At the end of every hexameter line, every one muſt be ſenſible of a complete cloſe or full pauſe; the cauſe of which follows. The two long ſyllables preceded by two ſhort, which always cloſe an hexameter line, are a fine preparation for a pauſe: for long ſyllables, or ſyllables pronounced ſlow, reſembling a ſlow and languid motion tending to reſt, naturally incline the mind to reſt, or, which is the ſame, to pauſe; and to this inclination the two preceding ſhort ſyllables contribute, which, by contraſt, make the ſlow pronunciation of the final ſyllables the more conſpicuous. Beſide this complete cloſe or full pauſe at the end, others are alſo requiſite for the ſake of melody; of which two are clearly diſcoverable, and perhaps there may be more. The longeſt and moſt remarkable ſucceeds the 5th portion: the other, which, being ſhorter and more faint, may be called the *ſemipauſe*, ſucceeds the 8th portion. So ſtriking is the pauſe firſt mentioned, as to be diſtinguiſhed even by the rudeſt ear: the monkiſh rhymes are evidently built upon it; in which, by an invariable rule, the final word always chimes with that which immediately precedes the pauſe:

De planctu cudo || metrum cum carmine nudo
Mingere cum bumbis || res eſt ſaluberrima lumbis.

The difference of time in the pauſe and ſemipauſe occaſions another difference not leſs remarkable; that it is lawful to divide a word by a ſemipauſe, but never by a pauſe, the bad effect of which is ſenſibly felt in the following examples:

Effuſus labor at||que immitis rupta Tyranni
Again:
Obſervans nido im||plumes detraxit; at illa
Again:
Loricam quam De||moleo detraxerat ipſe

The dividing a word by a ſemipauſe has not the ſame bad effect:

Jamque pedem referens || caſus e|vaſerat omnes.
Again:
Qualis populea || mœrens Philo|mela ſub umbra
Again:
Ludere que vellem || calamo per|miſit agreſti.

Lines, however, where words are left entire, without being divided even by a ſemipauſe, run by that means much the more ſweetly.

Nec gemere aërea || ceſſabit | turtur ab ulmo.
Again:
Quadrupedante putrem || ſonitu quatit | ungula campum.
Again:
Eurydicen toto || referebant | flumine ripæ.

The reaſon of theſe obſervations will be evident upon the ſlighteſt reflection. Between things ſo intimately connected in reading aloud as are ſenſe and ſound, every degree of diſcord is unpleaſant: and for that reaſon it is a matter of importance to make the muſical pauſes coincide as much as poſſible with thoſe of ſenſe; which is requiſite more eſpecially with reſpect to the pauſe, a deviation from the rule being leſs remarkable in a ſemipauſe. Conſidering the matter as to melody ſolely, it is indifferent whether the pauſes be at the end of words or in the middle; but when we carry the ſenſe along, it is diſagreeable to find a word ſplit into two by a pauſe, as if there were really two words: and though the diſagreeableneſs here be connected with the ſenſe only, it is by an eaſy tranſition of perceptions transferred to the ſound; by which means we conceive a line to be harſh and grating to the ear, when in reality it is only ſo to the underſtanding.

To the rule that fixes the pauſe after the 5th portion there is one exception, and no more. If the ſyllable ſucceeding the 5th portion be ſhort, the pauſe is ſometimes poſtponed to it:

Pupillis quos dura || premit cuſtodia matrum
Again:
In terras oppreſſa || gravi ſub religione
Again:
Et quorum pars magna || fui; quis talia fando

This contributes to diverſify the melody; and, where the words are ſmooth and liquid, is not ungraceful; as in the following examples:

Formoſam reſonare||doces Amaryllida ſylvas

Again:

Agricolas, quibus ipſa||procul diſcordibus armis

If this pauſe, placed as aforeſaid after the ſhort ſyllable, happen alſo to divide a word, the melody by theſe circumſtances is totally annihilated. Witneſs the following line of Ennius, which is plain proſe:

Romæ mœnia terru||it impiger | Hannibal armis.

182 Senſe.

Hitherto the arrangement of the long and ſhort ſyllables of an hexameter line and its different pauſes have been conſidered with reſpect to melody: but to have a juſt notion of hexameter verſe, theſe particulars muſt alſo be conſidered with reſpect to ſenſe. There is not perhaps in any other ſort of verſe ſuch latitude in the long and ſhort ſyllables; a circumſtance that contributes greatly to that richneſs of melody which is remarkable in hexameter verſe, and which made Ariſtotle pronounce that an epic poem in any other verſe would not ſucceed*. One defect, however, muſt not be diſſembled, that the ſame means which contribute to the richneſs of the melody render it leſs fit than ſeveral other ſorts for a narrative poem. There cannot be a more artful contrivance, as above obſerved, than to cloſe an hexameter line with two long ſyllables preceded by two ſhort: but unhappily this conſtruction proves a great embarraſſment to the ſenſe; which will thus be evident. As in general there ought to be a ſtrict concordance between the thought and the words in which it is dreſſed; ſo, in particular, every cloſe in the ſenſe ought to be accompanied with a cloſe in the ſound. In proſe this law may be ſtrictly obſerved, but in verſe the ſame ſtrictneſs would occaſion inſuperable difficulties. Willing to ſacrifice to the melody of verſe ſome ſhare of the concordance between thought and expreſſion, we freely excuſe the ſeparation of the muſical pauſe from that of the ſenſe during the courſe of a line; but the cloſe of an hexameter line is too conſpicuous to admit this liberty: for which reaſon there ought always to be ſome pauſe in the ſenſe at the end of every hexameter line, were it but ſuch a pauſe as is marked by a comma; and for the ſame reaſon there ought never to be a full cloſe in the ſenſe but at the end of a line, becauſe there the melody is cloſed. An hexameter line, to preſerve its melody, cannot well admit any great relaxation; and yet, in a narrative poem, it is extremely difficult to adhere ſtrictly to the rule even with theſe indulgences. Virgil, the chief of poets for verſification, is forced often to end a line without any cloſe in the ſenſe, and as often to cloſe the ſenſe during the running of a line; though a cloſe in the melody during the movement of the thought, or a cloſe in the thought during the movement of the melody, cannot be agreeable.

183 Obſervations on the accent.

The accent, to which we proceed, is not leſs eſſential than the other circumſtances above handled. By a good ear it will be diſcerned, that in every line there is one ſyllable diſtinguiſhable from the reſt by a capital accent: That ſyllable being the ſeventh portion, is invariably long

Nec bene promeritis||capitûr nec | tangitur ira

Again:

Non ſibi ſed toto||genitûm ſe | credere mundo

Again:

Qualis ſpelunca||ſubitô com|mota columba

In theſe examples the accent is laid upon the laſt ſyllable of a word; which is favourable to the melody in the following reſpect, that the pauſe, which for the ſake of reading diſtinctly muſt follow every word, gives opportunity to prolong the accent. And for that reaſon, a line thus accented has a more ſpirited air than when the accent is placed on any other ſyllable. Compare the foregoing lines with the following.

Alba neque Aſſyrio||fucâtur | lana veneno

Again:

Panditur interea||domus ômnipo|tentis Olympi

Again:

Olli ſedato||reſpôndit | corde Latinus.

In lines where the pauſe comes after the ſhort ſyllable ſucceeding the 5th portion, the accent is diſplaced, and rendered leſs ſenſible: it ſeems to be ſplit into two, and to be laid partly on the 5th portion, and partly on the 7th, its uſual place; as in

Nuda genu, nodôque||ſinûs col|lecta fluentes.

Again:

Formoſam reſonâre||docês Amar|yllida ſylvas.

Beſide this capital accent, ſlighter accents are laid upon other portions; particularly upon the 4th, unleſs where it conſiſts of two ſhort ſyllables; upon the 9th, which is always a long ſyllable; and upon the 11th, where the line concludes with a monoſyllable. Such concluſion, by the by, impairs the melody, and for that reaſon is not to be indulged unleſs where it is expreſſive of the ſenſe. The following lines are marked with all the accents.

Ludere quæ vêllem calamô permiſit agreſti

Again:

Et duræ quêrcus ſudâbunt rôſcida mella

Again:

Parturiunt môntes, naſcêtur rîdiculûs mus.

184 Order and arrangement do not conſtitute the whole melody of an hexameter verſe.

Reflecting upon the melody of hexameter verſe, we find, that order or arrangement doth not conſtitute the whole of it: for when we compare different lines, equally regular as to the ſucceſſion of long and ſhort ſyllables, the melody is found in very different degrees of perfection; which is not occaſioned by any particular combination of dactyles and ſpondees, or of long and ſhort ſyllables, becauſe we find lines where dactyles prevail, and lines where ſpondees prevail, equally melodious. Of the former take the following inſtance:

Æneadum genitrix hominum divumque voluptas.

Of the latter:

Molli paulatim flaveſcet campus ariſta.

What can be more different as to melody than the two following lines, which, however, as to the ſucceſſion of long and ſhort ſyllables, are conſtructed preciſely in the ſame manner?

Spond. Dact. Spond. Spond. Dact. Spond
Ad talos ſtola dimiſſa et circumdata palla. *Hor.*

Spond. Dact. Spond. Spond Dact, Spond.
Placatumque nitet diffuſo lumine cœlum. *Lucret.*

In the former, the pauſe falls in the middle of a word, which is a great blemiſh, and the accent is diſturbed by a harſh eliſion of the vowel *a* upon the particle *et*. In the latter, the pauſes and the accent are all of them diſtinct and full: there is no eliſion; and the words are more liquid and ſounding. In theſe particulars conſiſts the beauty of an hexameter line with reſpect to melody; and by neglecting theſe, many lines in the ſatires and epiſtles of Horace are leſs agreeable than plain proſe; for they are neither the one nor the other in perfection. To draw melody from theſe lines, they muſt be pronounced without relation to the ſenſe: it muſt not be regarded that words are divided by pauſes, nor that harſh eliſions are multiplied. To add to the account, proſaic low-ſounding words are introduced; and, which is ſtill worſe, accents are laid on them. Of ſuch faulty lines take the following inſtances.

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* Poet. cap. 25.

Candida rectaque ſit, munda hactenus ſit neque longa.

Jupiter exclamat ſimul atque audirit; at in ſe

Cuſtodes, lectica, ciniflones, paraſitæ

Optimus eſt modulator, ut Alfenus Vafer omni

Nunc illud tantum quæram, meritone tibi ſit.

Theſe obſervations on pauſes and ſemipauſes, and on the ſtructure of an hexameter line, are doubtleſs ingenious; but it is by no means certain that a ſtrict attention to them would aſſiſt any man in the writing of ſuch verſes as would have been pleaſing to a Roman ear. Many of his Lordſhip's rules have no other foundation than what reſts on our improper mode of accenting Latin words; which to Virgil or Lucretius would probably have been as offenſive as the Scotch accent is to a native of Middleſex.

II. Next in order comes ENGLISH HEROIC VERSE; which ſhall be examined under the heads of *number*, *accent*, *quantity*, *movement*, and *pauſe*. Theſe have been treated in ſo clear and maſterly a manner by Sheridan in his Art of Reading, that we ſhall have little more to do than abridge his doctrine, and point out the few inſtances in which attachment to a ſyſtem and partiality to his native tongue ſeem to have betrayed him into error, or at leaſt made him carry to an extreme what is juſt only when uſed with moderation.

“ Numbers, in the ſtrict ſenſe of the word*, whether with regard to poetry or muſic, conſiſt in certain impreſſions made on the ear at ſtated and regular diſtances. The loweſt ſpecies of numbers is a *double* ſtroke of the ſame note or ſound, repeated a certain number of times, at equal diſtances. The repetition of the ſame *ſingle* note in a continued ſeries, and exactly at equal diſtances, like the tickling of a clock, has in it nothing numerous; but the ſame note, *twice* ſtruck a certain number of times, with a pauſe between each *repetition* of double the time of that between the *ſtrokes*, is numerous. The reaſon is, that the pleaſure ariſing from *numbers*, conſiſts in the obſervation of *proportion;* now the repetition of the ſame note, in exactly the *ſame intervals*, will admit of no proportion. But the ſame note *twice* ſtruck, with the pauſe of *one* between the two ſtrokes, and repeated again at the diſtance of a pauſe equal to *two*, admits of the proportional meaſurement in the pauſes of *two* to *one*, to which time can be beaten, and is the loweſt and ſimpleſt ſpecies of numbers. It may be exemplified on the drum, as tu'm-tu'm--tu'm-tu'm--tu'm-tu'm, &c.

“ The next progreſſion of numbers is, when the ſame note is repeated, but in ſuch a way as that one makes a more ſenſible impreſſion on the ear than the other, by being more forcibly ſtruck, and therefore having a greater degree of loudneſs; as tĭ-tu'm--tĭ-tu'm; or, tu'm-tĭ--tu'm-tĭ: or when two weak notes precede a more forcible one, as tĭ-tĭ-tu'm--tĭ-tĭ-tu'm; or when the weak notes follow the forcible one, tu'm-tĭ-tĭ--tu'm-tĭ-tĭ.

“ In the firſt and loweſt ſpecies of numbers which we have mentioned, as the notes are exactly the ſame in every reſpect, there can be no proportion obſerved but in the time of the pauſes. In the ſecond, which riſes in a degree juſt above the other, though the notes are ſtill the ſame, yet there is a diverſity to be obſerved in their reſpective loudneſs and ſoftneſs, and therefore a meaſurable proportion of the quantity of ſound. In them we muſt likewiſe take into conſideration the order of the notes, whether they proceed from ſtrong to weak, or from weak to ſtrong; for this diverſity of order occaſions a great difference in the impreſſions made upon the ear, and in the effects produced upon the mind. To expreſs the diverſity of order in the notes in all its ſeveral kinds, the common term *movement* may be uſed, as the term *meaſure* will properly enough expreſs the different proportions of time both in the pauſes and in the notes.”

For it is to be obſerved, that all notes are not of the ſame length or on the ſame key. In poetry, as well as in muſic, notes may be high or low, flat or ſharp; and ſome of them may be prolonged at pleaſure. “ Poetic numbers are indeed founded upon the very ſame principles with thoſe of the muſical kind, and are governed by ſimilar laws (ſee MUSIC). Proportion and order are the ſources of the pleaſure which we receive from both; and the beauty of each depends upon a due obſervation of the laws of meaſure and movement. The eſſential difference between them is, that the matter of the one is articulate, that of the other inarticulate ſounds; but ſyllables in the one correſpond to notes in the other; poetic feet to muſical bars; and verſes to ſtrains; in a word, they have all like properties, and are governed by laws of the ſame kind.

“ From what has been ſaid, it is evident, that the *eſſence* of numbers conſiſts in certain impreſſions made on the mind through the ear at ſtated and regular diſtances of time, with an obſervation of a relative proportion in thoſe diſtances; and that the other circumſtances of long or ſhort in ſyllables, or diverſity of notes in uttering them, are *not* eſſentials but only *accidents* of poetic numbers. Should this be queſtioned, the objector might be ſilenced by having the experiment tried on a drum, on which, although it is incapable of producing long or ſhort, high or low notes, there is no kind of metre which may not be beat. That, therefore, which regulates the ſeries and movement of the impreſſions given to the ear by the recitation of an Engliſh verſe, muſt, when properly diſpoſed, conſtitute the eſſence of Engliſh poetic numbers; but it is the accent which particularly impreſſes the ſound of certain ſyllables or letters upon the ear; for in every word there is a ſyllable or letter accented. The neceſſity and uſe of the accent, as well in proſe as in verſe, we ſhall therefore proceed to explain.

“ As words may be formed of various numbers of ſyllables, from one up to eight or nine*, it was neceſſary that there ſhould be ſome peculiar mark to diſtinguiſh words from disjointed ſyllables, otherwiſe ſpeech would be nothing but a continued ſucceſſion of ſyllables conveying no ideas. This diſtinction of one word from another might be made by a perceptible pauſe at the end of each in ſpeaking, analogous to the diſtance made between them in writing and in printing. But theſe pauſes would make diſcourſe diſguſtingly tedious; and though they might render words ſufficiently diſtinct, they would make the meaning of ſentences extremely confuſed. Words might alſo be diſtinguiſhed from each other, and from a collection of detached ſyllables, by an *elevation* or *depreſſion* of the voice upon one ſyllable of each word; and this, as is well known to the learned, was the practice of the Greeks and Romans. But the Engliſh tongue has for this purpoſe adopted a mark of the eaſieſt and ſimpleſt kind, which is called *accent*. By accent is meant, a certain ſtreſs of the voice, upon a particular letter of a ſyllable, which diſtinguiſhes it from the reſt, and at the ſame time diſtinguiſhes the ſyllable itſelf to which it belongs from the other ſyllables which compoſe the word. Thus, in the word *hab'it*, the accent upon the *b* diſtinguiſhes that letter from the others, and the firſt ſyllable from the laſt; add more ſyllables to it, and it will ſtill do the ſame, as *hab'itable*. In the word *accep't*, the *p* is the diſtinguiſhed letter, and the ſyllable which contains it the diſtinguiſhed ſyllable; but if we add more ſyllables to it, as in the word *acceptable*, the ſeat of the accent is changed to the firſt ſyllable, of which *c* is the diſtinguiſhed letter. Every word in our language of more ſyllables than one has one of the ſyllables diſtinguiſhed from the reſt in this manner and every monoſyllable has a letter. Thus, in the word *hat'* the *t* is accented, in *háte* the vowel *a*, in *cub'* the *b*, and in *cúbe* the *u*: ſo that as articulation is the eſſence of ſyllables, accent is the eſſence of words; which without it would be nothing more than a mere ſucceſſion of ſyllables."

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* Art of Reading, vol. ii.

* Art of Reading, vol. i.

We have ſaid, that it was the practice of the Greeks and Romans to elevate or depreſs their voice upon one ſyllable of each word. In this elevation or depreſſion conſiſted their accent; but the Engliſh accent conſiſts in the mere ſtreſs of the voice, without any change of note. "Among the Greeks, all ſyllables were pronounced either in a high, low, or middle note; or elſe in a union of the high and low by means of the intermediate. The middle note, which was exactly at an equal diſtance between the high and the low, was that in which the unaccented ſyllables were pronounced. But every word had one letter, if a monoſyllable; or one ſyllable, if it conſiſted of more than one, diſtinguiſhed from the reſt; either by a note of the voice perceptibly higher than the middle note, which was called the *acute accent*; or by a note perceptibly, and in an equal proportion, lower than the middle one, which was called the *grave accent*; or by an union of the acute and grave on one ſyllable, which was done by the voice paſſing from the acute, through the middle note, in continuity down to the grave, which was called the *circumflex*."

"Now in pronouncing Engliſh words, it is true that one ſyllable is always diſtinguiſhed from the reſt, but it is not by any perceptible elevation or depreſſion of the voice, any high or low note, that it is done, but merely by dwelling longer upon it, or by giving it a more forcible ſtroke. When the ſtreſs or accent is on the vowel, we dwell longer on that ſyllable than on the reſt; as, in the words *glóry*, *fáther*, *hóly*. When it is on the conſonant, the voice, paſſing rapidly over the vowel, gives a ſmarter ſtroke to the conſonant, which diſtinguiſhes that ſyllable from others, as in the words *bat'tle*, *hab'it*, *bar'row*."

Having treated ſo largely of *accent* and *quantity*, the next thing to be conſidered in verſe will be quickly diſcuſſed; for in Engliſh it depends wholly on the ſeat of the accent. "When the accent or ſtreſs is on the vowel, the ſyllable is neceſſarily long, becauſe the accent cannot be made without dwelling on the vowel a longer time than uſual. When it is on the conſonant, the ſyllable is ſhort; becauſe the accent is made by paſſing rapidly over the vowel, and giving a ſmart ſtroke of the voice to the following conſonant. Thus the words *ad'd*, *led'*, *bid'*, *cub'*, are all ſhort, the voice paſſing quickly over the vowel to the conſonant; but for the contrary reaſon, the words *áll*, *láid*, *bíde*, *cúbe*, are long; the accent being on the vowels, on which the voice dwells ſome time before it takes in the ſound of the conſonant."

"Obvious as this point is, it has wholly eſcaped the obſervation of many an ingenious and learned writer. Lord Kames affirms*, that accenting is confined in Engliſh heroic verſe to the long ſyllables; for a ſhort ſyllable (ſays he) in not capable of an accent: and Dr Forſter, who ought to have underſtood the nature of the Engliſh accent better than his Lordſhip, aſks, whether we do not 'employ more time in uttering the *firſt* ſyllables of *heavily*, *haſtily*, *quickly*, *ſlowly*; and the *ſecond* in *ſolicit*, *miſtaking*, *reſearches*, *deluſive*, than in the *others*?' To this queſtion Mr Sheridan replies†, that "in ſome of theſe words we certainly do as the Doctor ſuppoſes; in *háſtily*, *ſlówly*, *miſtáking*, *delúſive*, for inſtance; where the accent being on the vowels renders their ſound long: but in all the others, *heav'-ily*, *quick'-ly*, *ſolis'-it*, *re-ſear'-ches*, where the accent is on the conſonant, the ſyllables *heav'*, *quick'*, *lis'*, *ſer'*, are pronounced as rapidly as poſſible, and the vowels are all ſhort. In the Scotch pronunciation (continues he) they would indeed be all reduced to an equal quantity, as thus; *hái-vily*, *háis-tily*, *quéek-ly*, *ſlów-ly*, *ſo-lée-cit*, *re-ſáir-ches*, *de-lú-ſive*. But here we ſee that the four ſhort ſyllables are changed into four long ones of a different ſound, occaſioned by their placing the ſeat of the accent on the vowels inſtead of the conſonants: thus inſtead of *hev'* they ſay *háiv*; for *quick'*, *quéek*; for *lis'*, *léece*; and for *ſer'*, *ſáir*.

"It appears therefore, that the quantity of Engliſh ſyllables is adjuſted by one eaſy and ſimple rule; which is, that when the ſeat of the accent is on a vowel, the ſyllable is long; when on a conſonant, ſhort; and that all unaccented ſyllables are ſhort. Without a due obſervation of quantity in reciting verſes there will be no poetic numbers; yet in compoſing Engliſh verſes the poet need not pay the leaſt attention to the quantity of his ſyllables, as meaſure and movement will reſult from the obſervation of other laws, which are now to be explained.

It has been affirmed by a writer* of great authority among the critics, that in Engliſh heroic verſe every line conſiſts of ten ſyllables, five ſhort and five long; from which there are but two exceptions, both of them rare. The firſt is, where each line of a couplet is made eleven ſyllables, by an additional ſhort ſyllable at the end.

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* El. of Crit. vol. ii.

† Art of Reading, vol. ii.

* Lord Kames.

> Thére héroes wit's are kep't in pond'rous váſes,
> And beaus' in ſnuff-boxes and tweezer-caſes.

The other exception, he ſays, concerns the ſecond line of a couplet, which is ſometimes ſtretched out to twelve ſyllables, termed an *Alexandrine line*

> A needleſs Alexandrine ends the ſong,
> That, like a wounded ſnake, drags its ſlow length along.

After what has been juſt ſaid, it is needleſs to ſtop for the purpoſe of pointing out the ingenious author's miſtake reſpecting long and ſhort ſyllables. Every attentive reader of what has been already laid down, muſt perceive, that in the firſt line of the former couplet, though there are no fewer than ſix accented ſyllables when it is properly read, yet of theſe there are but three that are long, *viz.* thoſe which have the accent on the vowel. Our buſineſs at preſent is, to ſhow the falſity of the rule which reſtrains the heroic line to ten ſyllables; and this we ſhall do by producing lines of a greater number.

> And the ſhrill ſounds ran echoing through the wood.

This line, though it conſiſts of eleven ſyllables, and has the laſt of thoſe accented, or, as Lord Kames would ſay, long, is yet undoubtedly a heroic verſe of very fine ſound. Perhaps the advocates for the rule may contend, that the vowel *o* in echoing ought to be ſtruck out by an apoſtrophe; but as no one reads,

> And the ſhrill ſounds ran ech'ing through the wood,

it is ſurely very abſurd to omit in writing what cannot be omitted in utterance. The two following lines have each eleven ſyllables, of which not one can be ſuppreſſed in recitation.

> Their glittering textures of the filmy dew,
> The great hierarchal ſtandard was to move.

Mr Sheridan quotes as a heroic line,

> O'er many a frozen, many a fiery Alp;

and obſerves what a monſtrous line it would appear, if pronounced,

> O'er man' a frozen, man' a fi'ry Alp,

inſtead of that noble verſe, which it certainly is, when all the thirteen ſyllables are diſtinctly uttered. He then produces a couplet, of which the former line has fourteen, and the latter twelve ſyllables.

> And many an amorous, many a humorous lay,
> Which many a bard had chaunted many a day.

That this is a couplet of very fine ſound cannot be controverted; but we doubt whether the numbers of it or of the other quoted line of thirteen ſyllables be truly heroic. To our ears at leaſt there appears a very perceptible difference between the movement of theſe verſes and that of the verſes of Pope or Dryden; and we think, that, though ſuch couplets or ſingle lines may, for the ſake of variety or expreſſion, be admitted into a heroic poem, yet a poem wholly compoſed of them would not be conſidered as heroic verſe. It has a much greater reſemblance to the verſe of Spencer, which is now broke into two lines, of which the firſt has eight and the ſecond ſix ſyllables. Nothing, however, ſeems to be more evident, from the other quoted inſtances, than that a heroic line is not confined to the ſyllables, and that it is not by the number of ſyllables that an Engliſh verſe is to be meaſured.

But if a heroic verſe in our tongue be not compoſed, as in French, of a certain number of ſyllables, how is it formed? We anſwer by feet, as was the hexameter line of the ancients; though between their feet and ours there is at the ſame time a great difference. The poetic feet of the Greeks and Romans are formed by quantity, thoſe of the Engliſh by ſtreſs or accent. "Though theſe terms are in continual uſe, and in the mouths of all who treat of poetic numbers, very confuſed and erroneous ideas are ſometimes annexed of them. Yet as the knowledge of the peculiar genius of our language with regard to poetic numbers and its characteriſtical difference from others in that reſpect, depends upon our having clear and preciſe notions of thoſe terms, it will be neceſſary to have them fully explained. The general nature of them has been already ſufficiently laid open, and we have now only to make ſome obſervation on their particular effects in the formation of metre.

"No ſcholar is ignorant that quantity is a term which relates to the length or the ſhortneſs of ſyllables, and that a long ſyllable is double the length of a ſhort one. Now the plain meaning of this is, that a long ſyllable takes up double the time in ſounding that a ſhort one does; a fact of which the ear alone can be the judge. When a ſyllable in Latin ends with a conſonant, and the ſubſequent ſyllable commences with one, every ſchool-boy knows that the former is long, to uſe the technical term, by the law of *poſition*. This rule was in pronunciation ſtrictly obſerved by the Romans, who always made ſuch ſyllables long by dwelling on the vowels; whereas the very reverſe is the caſe with us, becauſe a quite contrary rule takes place in Engliſh words ſo conſtructed, as the accent or ſtreſs of the voice is in ſuch caſes always transferred to the conſonant, and the preceding vowel being rapidly paſſed over, that ſyllable is of courſe ſhort.

"The Romans had another rule of proſody, that when one ſyllable ending with a vowel, was followed by another beginning with a vowel, the former ſyllable was pronounced ſhort; whereas in Engliſh there is generally an accent in that caſe on the former ſyllable, as in the word *pious*, which renders the ſyllable long. Pronouncing Latin therefore by our own rule, as in the former caſe, we make thoſe ſyllables ſhort which were ſounded long by them, ſo in the latter, we make thoſe ſyllables long which with them were ſhort. We ſay *ar'ma* and *virum'que*, inſtead of *árma* and *virúm'que*; *ſcío* and *túus*, inſtead of *ſció* and *tuus'*.

"Having made theſe preliminary obſervations, we proceed now to explain the nature of poetic feet. Feet in verſe correſpond to bars in muſic: a certain number of ſyllables connected form a foot in the one, as a certain number of notes make a bar in the other. They are called feet, becauſe it is by their aid that the voice as it were ſteps along through the verſe in a meaſured pace; and it is neceſſary that the ſyllables which mark this regular movement of the voice ſhould in ſome meaſure be diſtinguiſhed from the others. This diſtinction, as we have already obſerved, was made among the ancient Romans, by dividing their ſyllables into long and ſhort, and aſcertaining their quantity by an exact proportion of time in ſounding them; the long being to the ſhort as two to one; and the long ſyllables, being thus the more important, marked the movement of the verſe. In Engliſh, ſyllables are divided into accented and unaccented; and the accented ſyllables being as ſtrongly diſtinguiſhed from the unaccented, by the peculiar ſtreſs of the voice upon them, are as capable of marking the movement, and pointing out the regular paces of the voice, as the long ſyllables were by their quantity among the Romans. Hence it follows, that our accented ſyllables correſponding to their long ones, and our unaccented to their ſhort, in the ſtructure of poetic feet, an accented ſyllable followed by one unaccented in the ſame foot will anſwer to their *trochee*; and preceded by an unaccented one, to their *iambus*: and ſo with the reſt.

" All feet uſed in poetry conſiſt either of two or three ſyllables; and the feet among the ancients were denominated from the number and quantity of their ſyllables. The meaſure of quantity was the ſhort ſyllable, and the long one in time was equal to two ſhort. A foot could not conſiſt of leſs than two times, becauſe it muſt contain at leaſt two ſyllables; and by a law reſpecting numbers, which is explained elſewhere (ſee Music, a poetic foot would admit of no more than four of thoſe times. Conſequently the poetic feet were neceſſarily reduced to eight; ſour of two ſyllables, and four of three. Thoſe of two ſyllables muſt either conſiſt of two ſhort, called a *pyrrhic*; two long, called a *ſpondee*; a long and a ſhort, called a *trochee*; or a ſhort and a long, called an *iambus*. Thoſe of three ſyllables were, either three ſhort, a *tribrach*; a long and two ſhort, a *dactyl*; a ſhort, long, and ſhort, an *amphibrach*; or two ſhort and a long, an *anapæſt* (v).

We are now ſufficiently prepared for conſidering what feet enter into the compoſition of an Engliſh heroic verſe.

The Greeks and Romans made uſe of but two feet in the ſtructure of their hexameters; and the Engliſh heroic may be wholly compoſed of one foot, viz. the *iambic*, which is therefore the foot moſt congenial to that ſpecies of verſe. Our poetry indeed abounds with verſes into which no other foot is admitted. Such as,

The pow'rs | gave éar | and grán|ted hálf | his práy'r,
The reſt' | the wínds | diſpérs'd | in emp'|ty áir.

Our heroic line, however, is not wholly reſtrained to the uſe of this foot. In the opinion of Mr Sheridan it admits all the eight before enumerated; and it certainly excludes none, unleſs perhaps the *tribrach*. It is known to every reader of Engliſh poetry, that ſome of the fineſt heroic verſes in our language begin with a *trochee*; and that Pope, the ſmootheſt of all our verſifiers, was remarkable for his uſe of this foot, as is evident from the following example, where four ſucceeding lines out of ſix have a trochaic beginning.

Her lively looks a ſprightly mind diſcloſe,
Quick as | her eyes | and as unfix'd as thoſe:
Fávours | to none | to all ſhe ſmiles extends,
O'ſt ſhe | rejects | but never one offends.
Bright as | the ſun | her eyes the gazers ſtrike,
And like the ſun ſhe ſhines on all alike.

The uſe of this foot, however, is not neceſſarily confined to the beginning of a line. Milton frequently introduces it into other parts of the verſe; of which take the following inſtances:

That áll | was loſt' | back' to | the thick'|et ſlunk—
Of E've | whoſe ey'e | dárted contá|gious fire.

The laſt line of the following couplet begins with a *pyrrhic*:

She ſáid,—and mél|ting as in tears ſhe lay,
Iň ă | ſoft síl'ver ſtream diſſolv'd away;

But this foot is introduced likewiſe with very good effect into other parts of the verſe, as

Pánt on | thy lip' | aňd tŏ | thy heárt | be preſt.|
The phantom flies me | ăs ŭn|kind as you.
Leaps o'er the fence with eaſe | ĭntŏ | the fold.
Aňd thĕ|ſhrill' ſoúnds | ran echoing through the wood.

In this laſt line we ſee that the firſt foot is a *pyrrhic*, and the ſecond a *ſpondee*; but in the next the two firſt feet are *ſpondees*.

Hill's peép | o'er hill's | and Alps | on Alps | ariſe.

In the following verſe a trochee is ſucceeded by two ſpondees, of which the former is a genuine ſpondee by quantity, and the latter equivalent to a ſpondee by accent.

Sée thĕ | bōld yōuth | ſtráin up' | the threat|'ning ſteep.

We ſhall now give ſome inſtances of lines containing both the *pyrrhic* and the *ſpondee*, and then proceed to the conſideration of the other four feet.

Thăt ŏn | wēāk wings | from far purſues your flight.
Thrŏ' thĕ | faīr ſcēne | rōll ſlōw | the ling'ring ſtreams.
Oň hĕr | whīte breas't | a ſparkling croſs ſhe wore.

Of the four triſſyllabic feet, the firſt, of which we ſhall give inſtances in heroic lines, is the *dactyl*; as

Mur'muring, | and with | him' fled | the ſhades | of night.

Hov'ering

(v) For the convenience of the leſs learned reader we ſhall here ſubjoin a ſcheme of poetic feet, uſing the marks (- ˘) in uſe among the Latin grammarians to denote the genuine feet by quantity; and the following marks (' ˘) to denote the Engliſh feet by accent which anſwer to thoſe.

	Roman	Engliſh		Roman	Engliſh
Trochee	- ˘	' ˘	Dactyl	- ˘ ˘	' ˘ ˘
Iambus	˘ -	˘ '	Amphibrach	˘ - ˘	˘ ' ˘
Spondee	- -	' '	Anapæſt	˘ ˘ -	˘ ˘ '
Pyrrhic	˘ ˘	˘ ˘	Tribrach	˘ ˘ ˘	˘ ˘ ˘

Hov'ering | on wing | un'der | the cápe | of hell'.
Tim'orous | and ſlothful yet he pleaſed the ear.
Of trúth | in word | míghtier | than they | in arms.

Of the *anapæſt* a ſingle inſtance ſhall ſuffice; for except by Milton it is not often uſed.

The great | hĭĕrár|chal ſtandard was to move.

The *amphibrach* is employed in the four following verſes, and in the three laſt with a very fine effect.

With wheels | yet hóvering o'er the ocean brim
Rous'd from their ſlumber on | thăt fíĕ|ry | couch.
While the | prŏmis'cŭous crowd ſtood yet aloof.
Throws his ſteep flight | ĭn mánў | ăn ai|ry whirl.

Having thus ſufficiently proved that the Engliſh heroic verſe admits of all the feet except the *tribrach*, it may be proper to add, that from the nature of our accent we have duplicates of theſe feet, viz. ſuch as are formed by quantity, and ſuch as are formed by the mere *ictus* of the voice; an opulence peculiar to our tongue, and which may be the ſource of a boundleſs variety. But as feet formed of ſyllables which have the *accent* or *ictus* on the conſonant are neceſſarily pronounced in leſs time than ſimilar feet formed by quantity, it may be objected, that the meaſure of a whole line, conſtructed in the former manner, muſt be ſhorter than that of another line conſtructed in the latter; and that the intermixture of verſes of ſuch different meaſures in the ſame poem muſt have a bad effect on the melody, as being deſtructive of proportion. This objection would be well founded, were not the time of the ſhort accented ſyllables compenſated by a ſmall pauſe at the end of each word to which they belong, as is evident in the following verſe:

Then rus'|tling crack'|ling craſh|ing thun'|der down.

This line is formed of iambics by accent upon conſonants, except the laſt ſyllable; and yet by means of theſe ſoft pauſes or reſts, the meaſure of the whole is equal to that of the following, which conſiſts of pure iambics by quantity.

O'er hēāps | of rū|in ſtālk'd | the ſtate|ly hīnd.

Movement of ſo much importance in verſification, regards the order of ſyllables in a foot, meaſure their quantity. The order of ſyllables reſpects their progreſs from ſhort to long or from long to ſhort, as in the Greek and Latin languages; or from ſtrong to weak or weak to ſtrong, *i. e.* from accented or unaccented ſyllables, as in our tongue. It has been already obſerved that an Engliſh heroic verſe may be compoſed wholly of iambics; and experience ſhows that ſuch verſes have a fine melody. But as the ſtreſs of the voice, in repeating verſes of pure iambics, is regularly on every ſecond ſyllable, ſuch uniformity would diſguſt the ear in any long ſucceſſion, and therefore ſuch changes were ſought for as might introduce the pleaſure of variety without prejudice to melody; or which might even contribute to its improvement. Of this nature was the introduction of the trochee to form the firſt foot of an heroic verſe, which experience has ſhown us is ſo far from ſpoiling the melody, that in many caſes it heightens it. This foot, however, cannot well be admitted into any other part of the verſe without prejudice to the melody, becauſe it interrupts and ſtops the uſual movement by another directly oppoſite. But though it be excluded with regard to pure melody, it may often be admitted into any part of the verſe with advantage to expreſſion, as is well known to the readers of Milton.

"The next change admitted for the ſake of variety, without prejudice to melody, is the intermixture of pyrrhics and ſpondees; in which two impreſſions in the one foot make up for the want of one in the other; and two long ſyllables compenſate two ſhort, ſo as to make the ſum of the quantity of the two feet equal to two iambics. That this may be done without prejudice to the melody, take the following inſtances:

Ŏn hĕr | whīte brēāſt | a ſparkling croſs ſhe wore.—
Nŏr thĕ | dēēp trăct | of hell—ſay firſt what cauſe.—

This intermixture may be employed *ad libitum*, in any part of the line; and ſometimes two ſpondees may be placed together in one part of the verſe, to be compenſated by two pyrrhics in another; of which Mr Sheridan quotes the following lines as inſtances:

Stōōd rūl'd | ſtōōd vāſt | ĭnf ĭn|ĭtŭde | confined.
Shē āll | nīght lōng | hĕr ămŏ|rŏus dĕs|cant ſung.

That the former is a proper example, will not perhaps be queſtioned; but the third foot in the latter is certainly no pyrrhic. As it is marked here and by him, it is a tribrach; but we appeal to our Engliſh readers, if it ought not to have been marked an amphibrach by accent, and if the fourth foot be not an iambus. To us the feet of the line appear to be as follow:

Shē āll | nīght lōng | hĕr am'ŏ|rŏus des'|cănt ſun'g.

It is indeed a better example of the proper uſe of the amphibrach than any which he has given, unleſs perhaps the two following lines:

Up to | thĕ fíĕ|ry con|căve tow'ĕr|ing high
Thrōws hĭs | ſtēēp flight | ĭn man'ў | ăn áĭ|ry whīrl.

That in theſe three lines the introduction of the amphibrach does not hurt the melody, will be acknowledged by every perſon who has an ear; and thoſe who have not, are not qualified to judge. But we appeal to every man of taſte, if the two amphibrachs ſucceeding each other in the laſt line do not add much to the expreſſion of the verſe. If this be queſtioned, we have only to change the movement to the common iambic, and we ſhall diſcover how feeble the line will become.

Throws his | ſteep flight | in man|y ai|ry whirls.

This is ſimple deſcription, inſtead of that magical power of numbers which to the imagination produces the object itſelf, *whirling* as it were round an axis.

Having thus ſhown that the iambus, ſpondee, pyrrhic, and ampibrach, by accent, may be uſed in our meaſure with great latitude; and that the trochee may at all times begin the line, and in ſome caſes with advantage to the melody; it now remains only to add, that the dactyl, having the ſame movement, may be introduced in the place of the trochee; and the anapæſt in the place of the iambus. In proof of this, were not the article ſwelling in our hands, we could adduce many inſtances which would ſhow what an inexhauſtible fund of riches, and what an immenſe variety of materials, are prepared for us, "to build the lofty rhyme." But we haſten to the next thing to be conſidered in the art of verſifying, which is known by the name of *pauſes*.

"Of the poetic pauſes there are two ſorts, the *ceſural* and the *final*. The ceſural divides the verſe into equal or unequal parts; the final cloſes it. In a verſe there may be two or more ceſural pauſes, but it is evident that there can be but one final. As the final pauſe concerns the reader more than the writer of verſes, it has been ſeldom treated of by the critics. Yet as it is this final pauſe which in many caſes diſtinguiſhes verſe from proſe, it cannot be improper in the preſent article to ſhow how it ought to be made. Were it indeed a law of our verſification, that every line ſhould terminate with a ſtop in the ſenſe, the boundaries of the meaſure would be fixed, and the nature of the final pauſe could not be miſtaken. But nothing has puzzled the bulk of readers, or divided their opinions, more than the manner in which thoſe verſes ought to be recited, where the ſenſe does not cloſe with the line; and whoſe laſt words have a neceſſary connection with thoſe that begin the ſubſequent verſe. "Some (ſays Mr Sheridan) who ſee the neceſſity of pointing out the metre, pronounce the laſt word of each line in ſuch a note as uſually accompanies a comma, in marking the ſmalleſt member of a ſentence. Now this is certainly improper, becauſe it makes that appear to be a complete member of a ſentence which is an incomplete one; and by disjoining the ſenſe as well as the words, often confounds the meaning. Others again, but theſe fewer in number, and of the more abſurd kind, drop their voice at the end of every line, in the ſame note which they uſe in marking a full ſtop; to the utter annihilation of the ſenſe. Some readers (continues our author) of a more enthuſiaſtic kind, elevate their voices at the end of all verſes to a higher note than is ever uſed in the ſtops which divide the meaning. But ſuch a continued repetition of the ſame high note becomes diſguſting by its monotony, and gives an air of chanting to ſuch recitation. To avoid theſe ſeveral faults, the bulk of readers have choſen what they think a ſafer courſe, which is that of running the lines one into another without the leaſt pauſe, where they find none in the ſenſe; but by this mode of recitation they reduce poetry to ſomething worſe than proſe, to verſe run mad.

But it may be aſked, if this final pauſe muſt be marked neither by an elevation nor by a depreſſion of the voice, how is it to be marked at all? To which Mr Sheridan replies, by making no change whatever in the voice before it. This will ſufficiently diſtinguiſh it from the other pauſes, the comma, ſemicolon, &c. becauſe ſome change of note, by raiſing or depreſſing the voice, always precedes them, whilſt the voice is here only ſuſpended.

Now this pauſe of ſuſpenſion is the very thing wanting to preſerve the melody at all times, without interfering with the ſenſe. For it perfectly marks the bound of the metre: and being made only by a ſuſpenſion, not by a change of note in the voice, it never can affect the ſenſe; becauſe the ſentential ſtops, or thoſe which affect the ſenſe, being all made with a change of note, where there is no ſuch change, the ſenſe cannot be affected. Nor is this the only advantage gained to numbers by this ſtop of ſuſpenſion. It alſo prevents the monotony at the end of lines; which, however pleaſing to a rude, is diſguſting to a delicate, ear. For as this ſtop has no peculiar note of its own, but always takes that which belongs to the preceding word, it changes continually with the matter, and is as various as the ſenſe.

Having ſaid all that is neceſſary with regard to the final, we proceed now to conſider the ceſural, pauſe. To theſe two pauſes it will be proper to give the denomination of *muſical*, to diſtinguiſh them from the comma, ſemicolon, colon, and full ſtop, which may be called *ſentential pauſes*; the office of the former being to mark the melody, as that of the latter is to point out the ſenſe. The ceſural, like the final pauſe, ſometimes coincides with the ſentential; and ſometimes takes place where there is no ſtop in the ſenſe. In this laſt caſe, it is exactly of the ſame nature, and governed by the ſame laws with the pauſe of ſuſpenſion, which we have juſt deſcribed.

The ceſure, though not eſſential, is however a great ornament to verſe, as it improves and diverſifies the melody, by a judicious management in varying its ſituation; but it diſcharges a ſtill more important office than this. Were there no ceſure, verſe could aſpire to no higher ornament than that of ſimple melody; but by means of this pauſe there is a new ſource of delight opened in poetic numbers, correſpondent in ſome ſort to harmony in muſic. This takes its riſe from that act of the mind which compares the relative proportions that the members of a verſe thus divided bear to each other, as well as to thoſe in the adjoining lines. In order to ſee this matter in a clear light, let us examine what effect the ceſure produces in ſingle lines, and afterwards in comparing contiguous lines with each other.

With regard to the place of the ceſure, Mr Pope and others have expreſsly declared, that no line appeared muſical to their ears, where the ceſure was not after the fourth, fifth, or ſixth ſyllable of the verſe. Some have enlarged its empire to the third and ſeventh ſyllables; whilſt others have aſſerted that it may be admitted into any part of the line.

"There needs but a little diſtinguiſhing (ſays Mr Sheridan) to reconcile theſe different opinions. If melody alone is to be conſidered, Mr Pope is in the right when he fixes its ſeat in or as near as may be to the middle of the verſe. To form lines of the firſt melody, the ceſure muſt either be at the end of the ſecond or of the third foot, or in the middle of the third between the two. Of this movement take the following examples:

1. Of the ceſure at the end of the ſecond foot.

Our plenteous ſtreams || a various race ſupply;
The bright-ey'd per'ch || with fins of Tyrian dye;
The ſilver eél || in ſhining volumes roll'd;
The yellow carp' || in ſcales bedrop'd with gold.

2. At the end of the third foot.

With tender billet-doúx || he lights the pyre,
And breathes three amorous ſighs || to raiſe the fire.

3. Between the two, dividing the third foot.

The fields are ráviſh'd || from the induſtrious ſwains,
From men their cíties, || and from gods their fanes.

Theſe lines are certainly all of a fine melody, yet they are not quite upon an equality in that reſpect. Thoſe which have the ceſure in the middle are of the firſt order;

der; thoſe which have it at the end of the ſecond foot are next; and thoſe which have the pauſe at the end of the third foot the laſt. The reaſon of this preference it may not perhaps be difficult to aſſign.

In the pleaſure ariſing from comparing the proportion which the parts of a whole bear to each other, the more eaſily and diſtinctly the mind perceives that proportion, the greater is the pleaſure. Now there is nothing which the mind more inſtantaneouſly and clearly diſcerns, than the diviſion of a whole into two equal parts, which alone would give a ſuperiority to lines of the firſt order over thoſe of the other two. But this is not the only claim to ſuperiority which ſuch lines poſſeſs. The ceſure being on them always on an unaccented, and the final pauſe on an accented, ſyllable, they have a mixture of variety and equality of which neither of the other orders can boaſt, as in theſe orders the ceſural and final pauſes are both on accented ſyllables.

In the diviſion of the other two ſpecies, if we reſpect quantity only, the proportion is exactly the ſame, the one being as two to three, and the other as three to two; but it is the order or movement which here makes the difference. In lines where the ceſure bounds the ſecond foot, the ſmaller portion of the verſe is firſt in order, the greater laſt; and this order is reverſed in lines which have the ceſure at the end of the third foot. Now, as the latter part of the verſe leaves the ſtrongeſt and moſt laſting impreſſion on the ear, where the larger portion belongs to the latter part of the line, the impreſſion muſt in proportion be greater; the effect in ſound being the ſame as that produced by a climax in ſenſe, where one part riſes above another.

Having ſhown in what manner the ceſure improves and diverſifies the melody of verſe, we ſhall now treat of its more important office, by which it is the chief ſource of harmony in numbers. But, firſt, it will be neceſſary to explain what we mean by the term *harmony*, as applied to verſe.

Melody in muſic regards only the effects produced by ſucceſſive ſounds; and harmony, ſtrictly ſpeaking, the effects produced by different co-exiſting ſounds, which are found to be in concord. Harmony, therefore, in this ſenſe of the word, can never be applied to poetic numbers, of which there can be only one reciter, and conſequently the ſounds can only be in ſucceſſion. When therefore we ſpeak of the harmony of verſe, we mean nothing more than an effect produced by an action of the mind in comparing the different members of verſe already conſtructed according to the laws of melody with each other, and perceiving a due and beautiful proportion between them.

The firſt and loweſt perception of this kind of harmony ariſes from comparing two members of the ſame line with each other, divided in the manner to be ſeen in the three inſtances already given; becauſe the beauty of proportion in the numbers, according to each of theſe diviſions, is founded in nature. But there is a perception of harmony in verſification, which ariſes from the compariſon of two lines, and obſerving the relative proportion of their members; whether they correſpond exactly to each other by ſimilar diviſions, as in the couplets already quoted; or whether they are diverſified by ceſures in different places. As,

See the bold youth || ſtrain up the threatening ſteep,
Ruſh thro' the thickets || down the valleys ſweep.

Where we find the ceſure at the end of the ſecond foot of the firſt line, and in the middle of the third foot of the laſt.

Hang o'er their courſers heads || with eager ſpeed,
And earth rolls back || beneath the flying ſteed.

Here the ceſure is at the end of the third foot in the former, and of the ſecond in the latter line.——The perception of this ſpecies of harmony is far ſuperior to the former; becauſe, to the pleaſure of comparing the members of the ſame line with each other, there is ſuperadded that of comparing the different members of the different lines with each other; and the harmony is enriched by having four members of compariſon inſtead of two. The pleaſure is ſtill increaſed in comparing a greater number of lines, and obſerving the relative proportion of the couplets to each other in point of ſimilarity and diverſity. As thus,

Thy foreſts, Windſor, || and thy green retreats,
At once the monarch's || and the muſe's ſeats,
Invite my lays. || Be preſent ſylvan maids,
Unlock your ſprings || and open all your ſhades.

Here we find that the ceſure is in the middle of the verſe in each line of the firſt couplet, and at the end of the ſecond foot in each line of the laſt; which gives a ſimilarity in each couplet diſtinctly conſidered, and a diverſity when the one is compared with the other, that has a very pleaſing effect. Nor is the pleaſure leſs where we find a diverſity in the lines of each couplet, and a ſimilarity in comparing the couplets themſelves. As in theſe,

Not half ſo ſwift || the trembling doves can fly,
When the fierce eagle || cleaves the liquid ſky;
Not half ſo ſwiftly || the fierce eagle moves,
When thro' the clouds || he drives the trembling doves.

There is another mode of dividing lines well ſuited to the nature of the couplet, by introducing ſemipauſes, which with the ceſure divide the line into four portions. By a ſemipauſe, we mean a ſmall reſt of the voice, during a portion of time equal to half of that taken up by the ceſure; as will be perceived in the following fine couplet:

Warms | in the ſun || refreſhes | in the breeze,
Glows | in the ſtars || and bloſſoms | in the trees.

That the harmony, and of courſe the pleaſure, reſulting from poetic numbers, is increaſed as well by the ſemipauſe as by the ceſure, is obvious to every ear; becauſe lines ſo conſtructed furniſh a greater number of members for compariſon: but it is of more importance to obſerve, that by means of the ſemipauſes, lines which, ſeparately conſidered, are not of the fineſt harmony, may yet produce it when oppoſed to each other, and compared in the couplet. Of the truth of this obſervation, the following couplet, eſpecially as it ſucceeds that immediately quoted is a ſtriking proof:

Lives | thro' all life || extends | thro' all extent,
Spreads | undivided || operates | unſpent.

What we have advanced upon this ſpecies of verſe, will contribute to ſolve a poetical problem thrown out by Dryden as a crux to his brethren: it was to account for the peculiar beauty of that celebrated couplet in Sir John Denham's *Cooper's Hill*, where he thus deſcribes the Thames:

Verſification.

Tho' deep | yet clear || tho' gentle | yet not dull.
Strong | without rage || without o'erflowing | full.

This deſcription has great merit independent of the harmony of the numbers; but the chief beauty of the verſification lies in the happy diſpoſition of the pauſes and ſemipauſes, ſo as to make a fine harmony in each line when its portions are compared, and in the couplet when one line is compared with the other.

Having now ſaid all that is neceſſary upon pauſes and ſemipauſes, we have done the utmoſt juſtice to our ſubject which the limits aſſigned us will permit. *Feet* and *pauſes* are the conſtituent parts of verſe; and the proper adjuſtment of them depends upon the poet's knowledge of *numbers*, *accent*, *quantity*, and *movement*, all of which we have endeavoured briefly to explain. In conformity to the practice of ſome critics, we might have treated ſeparately of rhyme and of blank verſe; but as the eſſentials of all heroic verſes are the ſame, ſuch a diviſion of our ſubject would have thrown no light upon the art of Engliſh verſification. It may be juſt worth while to obſerve, that the pauſe at the end of a couplet ought to coincide, if poſſible, with a ſlight pauſe in the ſenſe, and that there is no neceſſity for this coincidence of pauſes at the end of any particular blank verſe. We might likewiſe compare our heroic line with the ancient hexameter, and endeavour to appreciate their reſpective merits; but there is not a reader capable of attending to ſuch a compariſon who will not judge for himſelf; and it may perhaps be queſtioned, whether there be two who will form preciſely the ſame judgment. Mr Sheridan, and all the mere Engliſh critics, give a high degree of preference to our heroic, on account of the vaſt variety of feet which it admits; whilſt the readers of Greek and Latin poetry prefer the hexameter, on account of its more muſical notes and majeſtic length.

Pogge || Poictou.

POGGE, the CATAPHRACTUS COTTUS in ichthyology. See COTTUS, n° 2.

POGGIUS BRACCIOLINUS, a man of great parts and learning, who contributed much to the revival of knowledge in Europe, was born at Terranuova, in the territories of Florence, in 1380. His firſt public employment was that of writer of the apoſtolic letters, which he held 10 years, and was then made apoſtolic ſecretary, in which capacity he officiated 40 years, under ſeven popes. In 1453, when he was 72 years of age, he accepted the employment of ſecretary to the republic of Florence, to which place he removed, and died in 1459. He viſited ſeveral countries, and ſearched many monaſteries, to recover ancient authors, numbers of which he brought to light: his own works conſiſt of moral pieces, orations, letters, and A Hiſtory of Florence from 1350 to 1455, which is the moſt conſiderable of them.

POGO, is a name by which the inhabitants of the Philippine iſlands diſtinguiſh their quail, which, though ſmaller, is in every other reſpect very like thoſe of Britain.

POICTIERS, an ancient, large, and conſiderable town of France, capital of Poictou. It was a biſhop's ſee, and contained four abbeys, a mint, an univerſity famous for law, 22 pariſhes, 9 convents for men, and 12 nunneries. There are here ſeveral Roman antiquities, and particularly an amphitheatre, but partly demoliſhed, and hid by the houſes. There is alſo a triumphal arch, which ſerves as a gate to the great ſtreet. It is not peopled in proportion to its extent. Near this place Edward the Black Prince gained a deciſive victory over the French, taking King John and his ſon Philip priſoners, in 1356, whom he afterwards brought over into England. See FRANCE, n° 71, &c.—It is ſeated on a hill on the river Clain, 52 miles ſouth-weſt of Tours, and 120 north by eaſt of Bourdeaux. E. Long. 0. 25. N. Lat. 46. 35.

POICTOU, a province of France, bounded on the north by Bretagne, Anjou, and part of Touraine: on the eaſt by Touraine, Berry, and Manche; on the ſouth by Angoumois, Saintonge, and the territory of Aunis; and on the weſt by the ſea of Gaſcony. It is divided into the Upper and Lower; and is fertile in corn and wine, and feeds a great number of cattle, particularly mules. It was in poſſeſſion of the kings of England for a conſiderable time, till it was loſt by the unfortunate Henry VI. Poictiers is the capital town.

Poictou || Poinciana.

Colic of Poictou. See MEDICINE, n° 303.

POINCIANA, BARBADOES FLOWER-FENCE: A genus of the monogynia order, belonging to the decandria claſs of plants; and in the natural method ranking under the 33d order, *Lomentaceæ*. The calyx is pentaphyllous; the petals five, the uppermoſt larger than the reſt; the ſtamina long, and all fertile; the ſeed veſſel a legumen. There is only one ſpecies, viz. the pulcherrima, a native of both Indies. It riſes with a ſtraight ſtalk 10 or 12 feet high, which is covered with a grey bark, and is ſometimes as thick as the ſmall of a man's leg, dividing into ſeveral ſpreading branches at the top, which are armed at each joint with two ſhort, crooked, ſtrong ſpines, and garniſhed with decompound winged leaves, each leaf conſiſting of ſix or eight pair of ſimple winged leaves. They are of a light green colour, and when bruiſed emit a ſtrong odour. The branches are terminated by looſe ſpikes of flowers, which are ſometimes formed into a kind of pyramid, and at others diſpoſed more in the form of an umbel. The footſtalk of each flower is near three inches long; the flower is compoſed of five petals, which are roundiſh at the top, but are contracted to narrow tails at the baſe. They ſpread open, and are beautifully variegated with a deep red or orange colour, yellow, and ſome ſpots of green; and emit a very agreeable odour. After the flower is paſt, the germen becomes a broad flat pod three inches long, divided into three or four cells by tranſverſe partitions, each including one flattiſh irregular ſeed. The plant is propagated by ſeeds; but, being tender, is to be conſtantly kept in the bark-ſtove. It is very impatient of moiſture in winter; and if the leaſt damp ſeizes its top, it either kills the plant or deſtroys its head. In ſome parts of Europe it may be made to grow taller than in the places where it is native; but its ſtems will not be thicker than a man's finger. In Barbadoes it is planted in hedges to divide the lands, whence it has the name of *flower-fence*. In the Weſt Indies, its leaves are made uſe of as a purge inſtead of ſenna; and in Jamaica it is called *ſenna*.

POINT, a term uſed in various arts.

Point, in grammar, a character uſed to mark the diviſions of diſcourſe (See Comma, Colon, &c.) A point proper is what we otherwiſe call a *full ſtop* or *period*. See Punctuation.

Point, in geometry, according to Euclid, is that which hath neither parts nor magnitude.

Point, in muſic, a mark or note anciently uſed to diſtinguiſh the tones or ſounds: hence we ſtill call it *ſimple counter-point*, when a note of the lower part anſwers exactly to that of an upper; and *figurative counter-point*, when any note is ſyncopated, and one of the parts makes ſeveral notes or inflections of the voice, while the other holds on one.

We ſtill uſe a point, to raiſe the value of a note, and prolong its time by one half, *e. g.* a point added to a ſemibreve inſtead of two minims, make it equal to three; and ſo of the other notes. See the article Time.

Point, in aſtronomy, a term applied to certain points or places marked in the heavens, and diſtinguiſhed by proper epithets.

The four grand points or diviſions of the horizon, viz. the eaſt, weſt, north, and ſouth, are called the *cardinal points*.

The zenith and nadir are the vertical points; the points wherein the orbits of the planets cut the plane of the ecliptic are called the *nodes*: the points wherein the equator and ecliptic interſect are called the *equinoctial points*; particularly, that whence the ſun aſcends towards the north pole, is called the *vernal point*; and that by which he deſcends to the ſouth pole, the *autumnal point*. The points of the ecliptic, where the ſun's aſcent above the equator, and deſcent below it, terminate, are called the *ſolſtitial point*; particularly the former of them, the *eſtival* or *ſummer-point*; the latter, the *brumal* or *winter-point*.

Point is alſo uſed for a cape or headland jutting out into the ſea: thus ſeamen ſay, two points of land are in one another, when they are ſo in a right line againſt each other, as that the innermoſt is hindered from being ſeen by the outermoſt.

Point, in perſpective, is uſed for various poles or places, with regard to the perſpective plane. See Perspective.

Point is alſo an iron or ſteel inſtrument, uſed with ſome variety in ſeveral arts. Engravers, etchers, cutters in wood, &c. uſe points to trace their deſigns on the copper, wood, ſtone, &c. See the articles Engraving, &c.

Point, in the manufactories, is a general term, uſed for all kinds of laces wrought with the needle; ſuch are the point le Venice, point de France, point de Genoa, &c. which are diſtinguiſhed by the particular economy and arrangement of their points.—*Point* is ſometimes uſed for lace woven with bobbins; as Engliſh point, point de Malines, point d'Havre, &c.

Point, in poetry, denotes a lively briſk turn or conceit, uſually found or expected at the cloſe of an epigram. See Poetry, n° 169.

Point-Blank, in gunnery, denotes the ſhot of a gun levelled horizontally, without either mounting or ſinking the muzzle of the piece.—In ſhooting point-blank, the ſhot or bullet is ſuppoſed to go directly forward in a ſtraight line to the mark; and not to move in a curve, as bombs and highly elevated random-ſhots do.—When a piece ſtands upon a level plane, and is laid level, the diſtance between the piece and the point where the ſhot touches the ground firſt, is called the *point-blank* range of that piece; but as the ſame piece ranges more or leſs, according to a greater or leſs charge, the point-blank range is taken from that of a piece loaded with ſuch a charge as is uſed commonly in action. It is therefore neceſſary that theſe ranges of all pieces ſhould be known, ſince the gunner judges from thence what elevation he is to give to his piece when he is either farther from or nearer to the object to be fired at; and this he can do pretty nearly by ſight, after conſiderable practice.

POINTING, in grammar, the art of dividing a diſcourſe, by points, into periods and members of periods, in order to ſhow the proper pauſes to be made in reading, and to facilitate the pronunciation and underſtanding thereof. See the article Punctuation.

POINTS, in heraldry, are the ſeveral different parts of an eſcutcheon, denoting the local poſitions of any figure. See Heraldry, p. 441. col. 2.

Points, in electricity, are thoſe acute terminations of bodies which facilitate the paſſage of the electrical fluid from or to ſuch bodies. See Electricity.

Points, or *Vowel Points*, in the Hebrew language. See Philology, Sect. 1. n° 31, &c.

POISON, is any ſubſtance which proves deſtructive to the life of animals in a ſmall quantity, either taken by the mouth, mixed with the blood, or applied to the nerves. See Medicine, n° 261, 269, 303, 322, 408, &c. &c.

Of poiſons there are many different kinds, which are exceedingly various in their operations. The mineral poiſons, as arſenic and corroſive mercury, ſeem to attack the ſolid parts of the ſtomach, and to produce death by eroding its ſubſtance: the antimonials ſeem rather to attack the nerves, and to kill by throwing the whole ſyſtem into convulſions; and in this manner alſo moſt of the vegetable poiſons ſeem to operate. All of theſe, however, ſeem to be inferior in ſtrength to the poiſons of ſome of the more deadly kinds of ſerpents, which operate ſo ſuddenly that the animal bit by them will be dead before another that had ſwallowed arſenic would be affected.

Much has been written concerning a poiſon made uſe of by the African negroes, by the Americans, and by the Eaſt Indians. To this very ſtrange effects have been aſcribed. It has been ſaid that by this poiſon a man might be killed at any certain time; as, for inſtance, after the interval of a day, a week, a month, a year, or even ſeveral years. Theſe wonderful effects, however, do not ſeem worthy of credit; as the Abbé Fontana has given a particular account of an American poiſon called *ticunas*, which in all probability is the ſame with that uſed in Africa and the Eaſt Indies; and from his account it is extremely improbable that any ſuch effects could be produced with certainty.

With this poiſon the Abbé was furniſhed by Dr Heberden. It was cloſed and ſealed up in an earthen pot incloſed in a tin-caſe. Within the tin-caſe was a note containing the following words: "Indian poiſon, brought from the banks of the river of the Amazons by Don Pedro Maldonado. It is one of the ſorts mentioned in the Philoſophical Tranſactions, Vol. XLVII. N° 12." In the volume of the Philoſophical Tranſactions here quoted, mention is made of two poiſons little different in their activity; the one called the *poiſon of Lamas*, and the other of *Ticunas*. The poiſon in the earthen veſſel uſed by the Abbé Fontana was that of the ticunas; he was alſo furniſhed with a number of American arrows dipped in poiſon, but whether that of the lamas or ticunas he could not tell.

Our author begins his account of the nature of this poiſon with detecting ſome of the miſtakes which had been propagated concerning it.—It had been aſſerted, that the Ticunas poiſon proves noxious by the mere effluvia, but much more by the ſteam which exhales from it in boiling or burning: that, among the Indians, it is prepared only by women condemned to die; and that the mark of its being ſufficiently prepared is when the attendant is killed by its ſteam. All theſe aſſertions are by the Abbé refuted in the cleareſt manner. He expoſed a young pigeon to the ſmell of the poiſon when the veſſel was opened, to the ſteam of it when boiling, and to the vapour of it when burning to the ſides of the veſſel, without the animal's being the leaſt injured; on which, concluding that the vapours of this poiſon were not to be dreaded, he expoſed himſelf to them without any fear.

This poiſon diſſolves very readily even in cold water, and likewiſe in the vegetable and mineral acids. With oil of vitriol it becomes as black as ink, but not with the reſt of the acids. In oil of vitriol it alſo diſſolves more ſlowly than in any of the reſt. It does not efferveſce with acids or alkalis; neither does it alter milk, nor tinge it, except with the natural colour of the poiſon; nor does it tinge the vegetable juices either red or green. When examined by the microſcope, there is no appearance of regularity or cryſtallization; but it for the moſt part appears made up of very ſmall, irregular, roundiſh bodies, like vegetable juices. It dries without making any noiſe, and has an extremely bitter taſte when put upon the tongue.

The ticunas poiſon is harmleſs when put into the eyes; nor is it fatal when taken by the mouth, unleſs the quantity is conſiderable. Six grains of the ſolid poiſon, diſſolved in water, killed a young pigeon which drank it in leſs than 20 minutes. Five grains killed a ſmall Guinea-pig in 25 minutes. Eight grains killed a rabbit in an hour and eight minutes, &c. In thoſe experiments it was obſerved that much leſs poiſon was required to kill an animal whoſe ſtomach was empty than one that had a full ſtomach. Three rabbits and two pigeons were killed in leſs than 35 minutes by taking a doſe of three grains each on an empty ſtomach; but when the experiment was repeated on five animals with full ſtomachs, only one of them died.

The moſt fatal operation of this poiſon is when mixed with the blood. The ſmalleſt quantity, injected into the jugular vein, killed the animal as if by a ſtroke of lightning. When applied to wounds in ſuch a manner that the flowing of the blood could not waſh it away, the animal fell into convulſions and a train of fatal nervous ſymptoms, which put an end to its life in a few minutes. Yet, notwithſtanding theſe ſeeming affections of the nerves, the poiſon proved harmleſs when applied to the naked nerves themſelves, or even to the medullary ſubſtance of them ſlit open.

The ſtrength of this poiſon ſeems to be diminiſhed, and even deſtroyed, by mineral acids, but not at all by alkalis or ardent ſpirits; but if the freſh poiſon was applied to a wound, the application of mineral acids immediately after could not remove the pernicious effects. So far, indeed, was this from being the caſe, that the application of nitrous acid to the wounded muſcle of a pigeon killed the animal in a ſhort time without any poiſon at all.—The effects of the arrows were equally fatal with thoſe of the poiſon itſelf (A).

The poiſon of the viper is analogous in its effects to that of ticunas, but inferior in ſtrength; the latter killing more inſtantaneouſly when injected into a vein than even the poiſon of the moſt venomous rattleſnake.

The Abbé has, however, obſerved a difference in the action of the two poiſons upon blood taken out of the body. He cut off the head of a pigeon, and received its blood into two warm conical glaſſes, to the amount of about 80 drops into each. Into the blood contained in one porringer, he put four drops of water; and into the other four drops of the poiſon diſſolved in water as uſual. The event of this experiment was, that the blood, with which the water only was mixed, coagulated in a ſhort time; but that in which the poiſon was mixed did not coagulate at all. The poiſon of the viper alſo hinders the blood from coagulating, but gives it a much blacker tinge than the poiſon of the ticunas. The poiſon of the viper alſo proves certainly fatal when

injected

(A) Mr Paterſon, *in his travels in Africa, in the years* 1777-8-9, fell in with an European woman who had been wounded with a poiſoned arrow. Great pains had been taken to cure her, but in vain; for at different periods of the year an inflammation came on which was ſucceeded by a partial mortification. She told him that the wound was eaſily healed up; but in two months afterwards there was a certainty of its breaking out again, and this had been the caſe for many years. The Hottentots poiſon their arrows with a ſpecies of euphorbia. See Euphorbia.—The amaryllis diſticha, a large bulbous plant growing about the Cape of Good Hope, called *mad poiſon*, is uſed for the ſame purpoſe. The natives take the bulbs when they are putting out their leaves, cut them tranſverſely, extract a thick fluid, and keep it in the ſun till it acquires the conſiſtence of gum, when it is fit for uſe. With arrows poiſoned with this gum they kill antelopes and other ſmall animals intended for food. After they are wounded, the animals generally run for ſeveral miles, and are frequently not found till next day. When the leaves of this plant are young, the cattle are very fond of them, though they occaſion inſtant death. Mr Paterſon mentions another ſhrubby plant producing a nut, called by the Dutch *woolf gift* or *wolf poiſon*, the only poiſon uſeful to the European inhabitants. The nuts are roaſted like coffee, pulverized, and ſtuffed into ſome pieces of meat or a dead dog, which are thrown into the fields. By this means the voracious hyenas are generally killed. See Rhus.

injected into the veins, even in very ſmall quantity; but it produces a kind of grumous coagulation and blackneſs in the blood when drawn from a vein, though it prevents the proper coagulation of that fluid, and its ſeparation into craſſamentum and ſerum as uſual. See Viper.

In the Philoſophical Tranſactions, Nº 335. we have a number of experiments which ſhow the effects of many different poiſons upon animals; from whence it appears, that many ſubſtances which are not at all accounted poiſonous, yet prove as certainly fatal when mixed with the blood as even the poiſon of rattleſnakes, or the ticunas itſelf.—An ounce of emetic wine, being injected into the jugular vein of a large dog, produced no effect for a quarter of an hour. At the expiration of that ſpace he became ſick, had a continual vomiting, and evacuation of ſome hard excrements by ſtool. By theſe evacuations he ſeemed to be ſomewhat relieved; but ſoon grew uneaſy, moved from place to place, and vomited again. After this he laid himſelf down on the ground pretty quietly; but his reſt was diſturbed by a return of his vomiting, and his ſtrength greatly decreaſed. An hour and an half after the operation he appeared half dead, but was greatly revived by having ſome warm broth poured down his throat with a funnel. This, however, proved only a temporary relief; for in a ſhort time the vomiting returned, he made urine in great quantity, howled miſerably, and died in convulſions.—A dram and an half of ſal ammoniac diſſolved in an ounce and an half of water, and injected into the jugular vein of a dog, killed him with convulſions almoſt inſtantly.—The ſame effect followed from injecting a dram of ſalt of tartar diſſolved in an ounce of warm water; but a dram and an half of common ſalt injected into the jugular produced little other bad conſequence than a temporary thirſt.—A dram of purified white vitriol, injected into the crural vein of a dog, killed him immediately.—Fifteen grains of ſalt of urine diſſolved in an ounce of water, and injected into the crural vein of a dog, threw him into ſuch violent convulſions that he ſeemed to be dying; nevertheleſs he recovered from a ſecond doſe, though not without a great deal of difficulty: but an ounce of urine made by a man faſting produced no bad effect. Diluted aquafortis injected into the jugular and crural vein of a dog killed him immediately by coagulating the blood. Oil of ſulphur (containing ſome quantity of the volatile vitriolic acid) did not kill a dog after repeated trials. On the contrary, as ſoon as he was let go, he ran into all the corners of the room ſearching for meat: and having found ſome bones, he fell a gnawing them with ſtrange avidity, as if the acid, by injection into his veins, had given him a better appetite. Another dog who had oil of tartar injected into his veins, ſwelled and died, after ſuffering great torment. His blood was found florid, and not coagulated.—A drachm and a half of ſpirit of ſalt diluted with water, and injected into the jugular vein of a dog, killed him immediately. In the right ventricle of the heart the blood was found partly grumous and concreted into harder clots than ordinary, and partly frothy. Warm vinegar was injected without doing any manifeſt harm.—Two drachms of ſugar diſſolved into an ounce of water were injected into the jugular vein of a dog without any hurt.

Theſe are the reſults of the experiments where ſaline ſubſtances were injected into the veins. Many acrids proved equally fatal. A decoction of two drams of white hellebore, injected into the jugular vein of a dog, killed him like a ſtroke of lightning. Another dog was killed in a moment by an injection of an ounce of rectified ſpirit of wine in which a dram of camphor was diſſolved.—Ten drams of highly rectified ſpirit of wine, injected into the crural vein of a dog, killed him in a very ſhort time: he died quietly, and licking his jaws with his tongue as with pleaſure. In the vena cava and right ventricle of the heart the blood was coagulated into a great many little clots.—Three drachms of rectified ſpirit of wine injected into the crural vein of a ſmall dog made him apoplectic, and as it were half dead. In a little time he recovered from the apoplexy, and became giddy; and, when he endeavoured to go, reeled and fell down. Though his ſtrength increaſed by degrees, yet his drunkenneſs continued. His eyes were red and fiery; and his ſight ſo dull that he ſcarce ſeemed to take notice of any thing: and when he was beat, he would ſcarce move. However, in four hours he began to recover, and would eat bread when offered him; the next day he was out of danger.—Five ounces of ſtrong white-wine injected into the crural vein of a dog made him very drunk for a few hours, but did not produce any other conſequences. An ounce of ſtrong decoction of tobacco injected into a vein killed a dog in a very ſhort time in terrible convulſions. Ten drops of oil of ſage rubbed with half a dram of ſugar, and thus diſſolved in water, did no harm by being injected into the blood.

Mercury, though ſeemingly void of all acrimony, proves alſo fatal when injected into the blood. Soon after the injection of half an ounce of this mineral into the jugular vein of a dog, he was ſeized with a dry ſhort cough which came by intervals. About two days after, he was troubled with a great difficulty of breathing, and made a noiſe like that of a broken-winded horſe. There was no tumour about the root of the tongue or the parotid glands, nor any appearance of a ſalivation. In four days he died; having been for two days before ſo much troubled with an orthopnœa, that he could ſleep only when he leaned his head againſt ſomething. When opened, about a pint of bloody ſerum was found in the thorax, and the outſide of the lungs in moſt places was bliſtered. Some of the bliſters were larger and others ſmaller than a pea, but moſt of them contained mercurial globules. Several of them were broken; and upon being preſſed a little, the mercury ran out with a mixture of a little ſanies; but upon ſtronger preſſure, a conſiderable quantity of ſanies iſſued out. In the right ventricle of the heart ſome particles of quickſilver were found in the very middle of the coagulated blood lodged there, and the ſame thing alſo was obſerved in the pulmonary artery. Some blood alſo was found coagulated in a very ſtrange and unuſual manner between the columnæ of the right ventricle of the heart, and in this a greater quantity of quickſilver than anywhere elſe. In the left ventricle was found a very tenacious blood, coagulated, and ſticking to the great valve, including the tendons of it, and a little reſembling a polypus. No mercury could be found in this ventricle by the moſt diligent ſearch; whence it appears, that the mercury had paſſed no farther than the extremities of the pulmonary artery, where it had ſtuck and occaſioned fatal obſtructions.—In another dog, which had mercury injected into the jugular, it appears to have paſſed the pulmonary artery, as part of it was found in the cavity of the abdomen, and part alſo in ſome other cavities of the body. All the glandules were very turgid and full of liquor, eſpecially in the ventricles of the brain, and all round there was a great quantity of ſerum.

In like manner, oil of olives proves certainly fatal when injected into the blood. Half an ounce of this, injected into the crural vein of a dog, produced no effect in half a quarter of an hour: but after that, the animal barked, cried, looked dejected, and fell into a deep apoplexy; ſo that his limbs were deprived of all ſenſe and motion, and were flexible any way at pleaſure. His reſpiration continued very ſtrong, with a ſnorting and wheezing, and a thick humour ſometimes mixed with blood flowing out of his mouth. He loſt all external ſenſe: the eyes, though they continued open, were not ſenſible of any objects that were put to them; and even the cornea could be touched and rubbed, without his being the leaſt ſenſible of it: his eyelids, however, had a convulſive motion. The hearing was quite loſt; and in a ſhort time the feeling became ſo dull, that his claws and ears could be bored with red-hot pincers without his expreſſing the leaſt ſenſe of pain. Sometimes he was ſeized with a convulſive motion of the diaphragm and muſcles ſubſervient to reſpiration; upon which he would bark ſtrongly, as if he had been awake: but this waking was only in appearance; for all the time of this barking he continued as inſenſible as ever. In three hours he died; and on opening his body, the bronchiæ were filled with a thick froth.—An ounce of oil of olives injected into the jugular of another dog killed him in a moment; but a third lived an hour after it. He was ſeized with a great ſleepineſs, ſnorting, and wheezing, but did not bark like the firſt. In all of them a great quantity of thick froth was found in the lungs.

We come now to ſpeak of thoſe poiſons which prove mortal (B) when taken by the mouth. The principal of theſe are, arſenic, corroſive mercury, glaſs of antimony, and lead*. What the effects of theſe ſubſtances are when injected into the blood, cannot be related, as no experiments ſeem to have been made with them in that way, excepting antimony, whoſe effects have been already mentioned. The effects of opium, when injected into the veins, ſeem to be ſimilar to its effects when taken by the mouth. Fifty grains of opium, diſſolved in an ounce of water, were injected into the crural vein of a cat. Immediately after the operation ſhe ſeemed much dejected, but did not cry; only made a low, interrupted, and complaining noiſe. This was ſucceeded by trembling of the limbs, convulſive motions of the eyes, ears, lips, and almoſt all parts of the body, with violent convulſions of the breaſt. Sometimes ſhe would raiſe up her head, and ſeem to look about her; but her eyes were very dull, and looked dead. Though ſhe was let looſe, and had nothing tied about her neck, yet her mouth was ſo filled with froth, that ſhe was almoſt ſtrangled. At laſt, her convulſive motions continuing, and being ſeized with ſtretching of her limbs, ſhe died in a quarter of an hour. Upon opening the body, the blood was found not to be much altered from its natural ſtate.—A dram and an half of opium was diſſolved in an ounce and an half of water, and then injected into the crural vein of a luſty ſtrong dog. He ſtruggled violently; made a loud noiſe, though his jaws were tied: had a great difficulty of breathing, and palpitation of the heart; with convulſive motions of almoſt all parts of his body. Theſe ſymptoms were ſucceeded by a profound and apoplectic ſleep. Having untied him, he lay upon the ground without moving or making any noiſe, though ſeverely beaten. About half an hour after he began to recover ſome ſenſe, and would move a little when beaten. The ſleepineſs ſtill decreaſed; ſo that in an hour and a half he would make a noiſe and walk a little when beat. However, he died in four days, after having voided a quantity of fetid excrements, in colour reſembling the diluted opium he had ſwallowed.

* See Chemiſtry, n° 925, 1256, &c. Medicine as above referred to, and Pharmacy, paſſim.

The oil of tobacco has generally been reckoned a very violent poiſon when introduced into the blood; but from the Abbé Fontana's experiments, it appears to be far inferior in ſtrength to the poiſon of ticunas, or to the bite of a viper. A drop of oil of tobacco was put into a ſmall inciſion in the right thigh of a pigeon, and in two minutes the animal could not ſtand on its right foot. The ſame experiment was repeated on another pigeon and produced exactly the ſame effect. In another caſe, the oil was applied to a ſlight wound in the breaſt; three minutes after which, the animal could not ſtand on the left foot. This experiment was alſo repeated a ſecond time, with the ſame ſucceſs. A tooth-pick, ſteeped in oil of tobacco, and introduced into the muſcles of the breaſt, made the animal fall down in a few ſeconds as if dead. Applied to two others, they threw up ſeveral times all the food they had eaten. Two others treated in the ſame manner, but with empty ſtomachs, made many efforts to vomit.—In general, the vomiting was found to be a conſtant effect of this poiſon: but the loſs of motion in the part to which the poiſon is applied, was found to be only accidental. None of the animals died by the

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(B) Of all poiſons* thoſe which may be called culinary are perhaps the moſt deſtructive, becauſe they are generally the leaſt ſuſpected. All copper ‡ veſſels, therefore, and veſſels of bell-metal, which contains copper, ſhould be laid aſide. Even the common *earthen-ware*, when they contain acids, as in pickling, become very pernicious, as they are glazed with lead, which in the ſmalleſt quantity when diſſolved is very fatal; and even tin, the leaſt exceptionable of the metals for culinary purpoſes except iron, is not always quite free of poiſonous qualities, it having been found to contain a ſmall portion of arſenic. Muſhrooms and the common laurel are alſo very fatal. The bitter almond contains a poiſon, and its antidote likewiſe. The cordial dram *ratafia*, much uſed in France, is a ſlow poiſon, its flavour being procured from the kernels of peach, black cherry ſtones, &c.—The ſpirit of *lauro-ceraſus* is peculiarly fatal. The adulteration of bread, beer, wine, porter, &c. produces very fatal conſequences, and merits exemplary puniſhment. Next to culinary poiſons the abuſe of medicines deſerves particular attention.

* See Leake's Practical Treatiſe on Diſeaſes of the Viſcera.

‡ See Poiſon of Copper.

application of oil of tobacco. Dr Leake however aſſerts the contrary; ſaying, that this oil, which is uſed by the Indians in poiſoning arrows, when infuſed into a freſh wound, beſides ſickneſs and vomiting, occaſions convulſions and death. See *Practical Eſſay on Diſeaſes of the Viſcera*, p. 67.

The pernicious effects of laurel-water are taken notice of under the article MEDICINE, nº 261. The account is confirmed by the experiments of the Abbé Fontana; who tells us, that it not only kills in a ſhort time when taken by the mouth, but that, when given in ſmall doſes, the animal writhes ſo that the head joins the tail, and the vertebræ arch out in ſuch a manner as to ſtrike with horror every one who ſees it. In order to aſcertain the effects of this water when taken into the blood, our author opened the ſkin of the lower belly of a pretty large rabbit, and made a wound in it about an inch long; and having ſlightly wounded the muſcles under it in many parts, applied two or three tea ſpoonfuls of laurel-water. The animal fell down convulſed in leſs than three minutes, and died ſoon after. The experiment was repeated with ſimilar ſucceſs in other animals; but was always found to act moſt powerfully, and in the ſhorteſt time, when taken by the mouth, or injected by way of clyſter. From theſe experiments, however, he concluded, that laurel-water would kill by being injected into the blood: but in this he was deceived; for two rabbits had each of them a large teaſpoonful injected into the jugular vein, without any inconvenience either at the time of injection or afterwards. It proved innocent alſo when applied to the bare nerves, and even when introduced into their medullary ſubſtance.

We ought now to give ſome account of the proper antidotes for each kind of poiſon; but from what has been related concerning the extreme activity of ſome of them, it is evident that in many caſes there can be but very little hope. People are moſt apt to be bit by ſerpents in the legs or hands; and as the poiſon, from the Abbé Fontana's experiments, appears to act only in conſequence of being abſorbed into the blood, it is plain, that to prevent this abſorption is the chief indication of cure. We have recommended ſeveral methods for this purpoſe under the article MEDICINE, nº 408.; but the Abbé Fontana propoſes another not mentioned there, namely, ligature. This, if properly applied between the wounded part and the heart, muſt certainly prevent the bad effects of the poiſon: but then it tends to produce a diſeaſe almoſt equally fatal; namely, a gangrene of the part; and our author gives inſtances of animals being thus deſtroyed after the effects of the poiſon were prevented; for which reaſon he prefers amputation. But the good effects of either of theſe methods, it is evident, muſt depend greatly on the nature of the part wounded, and the time when the ligature is applied or the amputation performed. If the teeth of the ſerpent, or the poiſoned arrow, happens to ſtrike a large vein, the only poſſibility of eſcaping inſtant death is to compreſs the trunk of the vein above the wounded place, and to enlarge the wound, that the blood may flow freely and in large quantity, in order to waſh away the poiſon, and diſcharge the infected parts of the blood itſelf. If this is neglected, and the perſon falls into the agonies of death, perhaps ſtrongly ſtimulating medicines given in large doſes, and continued for a length of time, may enable nature to counteract the virulence of the poiſon. For this purpoſe volatile alkalis ſeem moſt proper, as acting ſooneſt. See MEDICINE, p. 346. col. 2. and p. 347. col. 1.; and perhaps a combination of them with ether might be advantageous, as by the volatility of that medicine the activity of the alkali would probably be increaſed. In the Philoſophical Tranſactions, we have an account of the recovery of a dog ſeemingly by means of the volatile alkali, when probably he was in a dying condition. This dog indeed ſeems to have had a remarkable ſtrength of conſtitution. The poor creature had firſt got two ounces of the juice of nightſhade, which he bore without any inconvenience. An equal quantity of the juice of hemlock was then given him without effect. He then got a large doſe of the root of wolfsbane with the ſame ſucceſs. Two drachms of white hellebore root were next given. Theſe cauſed violent vomitings and purgings, but ſtill he outlived the operation. He was then made to ſwallow five roots of the colchicum, or meadow-ſaffron, dug freſh out of the earth. The effect of theſe was ſimilar to that of the white hellebore, but ſtill he did not die. Laſtly, he got two drams of opium; and he even outlived this doſe. He was firſt caſt into a deep ſleep by it; but ſoon awaked, and was ſeized with violent vomitings and purgings, which carried off the effect of the opium. Seeing then that the animal had reſiſted the moſt violent poiſons, it was reſolved to try the effects of the bite of a viper; and he was accordingly bit three or four times on the belly a little below the navel by one enraged. The immediate conſequence of this was an incipient gangrene in the parts adjoining to the wound, as appeared by the riſing of little black bladders filled with a ſanious matter, and a livid colour which propagated itſelf all around. The motion of the heart became very faint and irregular, and the animal lay without ſtrength or ſenſation, as if he had been ſeized with a lethargy or apoplexy. In this condition his wound was cupped and ſcarified, and Venice treacle (a famous antidote) applied to it. In two hours after this all the ſymptoms were increaſed, and he ſeemed to be nearly dead; upon which half a drachm of volatile ſalt of hartſhorn mixed with a little broth was poured down his throat; and the conſequence was, that in a ſhort time he was able to ſtand on his feet and walk. Another doſe entirely diſpelled his lethargy, and the heart began to recover its ſtrength. However, he continued very weak; and though he eat no ſolid meat for three days, yet at the end of that time his ſtrength was evidently increaſed. The firſt day he drank water plentifully and greedily, and on the ſecond day he drank ſome broth. On the third day he began to eat ſolid meat, and ſeemed out of danger; only ſome large and foul ulcers remained on that part of the belly which was bit, and before theſe were healed he was killed by another dog.

From comparing this with ſome other obſervations, indeed, it would ſeem that volatile alkali is the beſt antidote againſt all poiſons which ſuddenly kill by a mixture with the blood, and even of ſome others. Indeed its effects in curing the bite of ſnakes ſeems to be put beyond all doubt, by a paper in the 2d volume of the Aſiatic Reſearches, p. 323. "From the effect of a ligature applied between the bitten part and the heart (ſays Mr Williams, the author of the paper), it is evident that the poiſon diffuſes itſelf over the body by the returning venous blood; deſtroying the irritability, and rendering the ſyſtem paralytic. It is therefore probable, that the volatile cauſtic alkali, in reſiſting the diſeaſe of the poiſon, does not act ſo much as a ſpecific in deſtroying its quality, as by counteracting the effect on the ſyſtem, by ſtimulating the fibres, and preſerving that irritability which it tends to deſtroy."

But whatever be the mode of its operation, the medicine is unqueſtionably powerful. Mr Williams uſed either the volatile cauſtic alkali, or eau-de-luce; the former of which he ſeems to have preferred. Of it he gave 60 drops as a doſe in water, and of the eau-de-luce he gave 40, at the ſame time applying ſome of the medicine to the part bitten, and repeating the doſe as he found occaſion. Of ſeven caſes, ſome of which were apparently very deſperate, only one died, and that appears to have been occaſioned by bad treatment after the cure. Many of the patients were perfectly recovered in ſeven or eight minutes, and none of them required more than two hours; On the whole, Mr Williams ſays that he "never knew an inſtance of the volatile cauſtic alkali failing in its effect, where the patient has been able to ſwallow it." Dr Mead aſſerts, that the alkali counteracts the deadly effects of laurel water; we have ſeen its effects in curing the bite of a viper, and of ſnakes; and from Dr Wolfe's experiments on hydrophobous patients, it may even claim ſome merit there. Still, however, there is another method of attempting a cure in ſuch deplorable caſes; and that is, by injecting into the veins any thing which will not deſtroy life, but will deſtroy the effects of the poiſon. It is much to be regretted, that in thoſe cruel experiments which we have already related, the intention ſeems almoſt always to have been to kill the animal at all events; whereas, it ought to have been to preſerve him alive, and to aſcertain what medicines could be ſafely injected into the blood, and what could not, with the effects which followed the injection of different quantities, none of which were ſufficient to deſtroy life. But in the way they were managed, ſcarce any concluſion can be drawn from them. Indeed it appears that little good is to be expected from this mode; it is mere ſpeculation, and future experiments muſt ſhow whether it ever ſhall be uſed for the cure of poiſons, or for any other purpoſes: its being now totally laid aſide, ſeems to militate ſtrongly againſt the efficacy of it; beſides, the extreme cruelty of the operation will ever be a ſtrong bar to its general introduction. See INJECTION.

There ſtill remains another method of cure in deſperate caſes, when there is a certainty that the whole maſs of blood is infected; and that is, by the bold attempt of changing the whole diſeaſed fluid for the blood of a ſound animal. Experiments of this kind have alſo been tried; and the method of making them, together with the conſequences of ſuch as are recorded in the Philoſophical Tranſactions, we ſhall notice under the article TRANSFUSION.

Dr Mead, finding that many pretenders to philoſophy have called the goodneſs of the Creator in queſtion, for having created ſubſtances whoſe manifeſt and obvious qualities are noxious and deſtructive, remarks, by way of anſwer, that they have alſo ſalutary virtues. But, beſides their phyſical effects, they are likewiſe food for animals which afford us good nouriſhment, goats and quails being fattened by hellebore, ſtarlings by hemlock, and hogs innocently eating henbane; beſides, ſome of thoſe vegetables, which were formerly thought poiſonous, are now uſed in medicine, and future diſcoveries may probably increaſe the number. The poiſon of many vegetables is their only defence againſt the ravages of animals; and by means of them we are often enabled to defend uſeful plants from the deſtroying inſect; ſuch as by ſprinkling them with eſſential oil of turpentine; and by means of ſome ſubſtances poiſonous to them, we are enabled to deſtroy thoſe inſects which infeſt the human body, and the bodies of domeſtic animals, &c.—As for poiſonous minerals, arſenic for example, Dr Mead obſerves, that it is not a perfect mineral, but only an active ſubſtance, made uſe of by nature in preparing ſeveral metals in the earth, which are of great ſervice to mankind; and, after confirming this by ſeveral inſtances, he concludes by ſaying, the caſe will be found much the ſame in all natural productions of this kind. As for poiſonous animals, &c. their noxious qualities may eaſily be accounted for, by reflecting that it is their only mode of ſelf-defence. See ARANEA, p. 195. and SERPENT.

Poiſon of Copper. This metal, though when in an undiſſolved ſtate it produces no ſenſible effects, becomes exceedingly active when diſſolved; and ſuch is the facility with which the ſolution is effected, that it becomes a matter of ſome conſequence to prevent the metal from being taken into the human body even in its proper form. It doth not, however, appear that the poiſon of copper is equally pernicious with thoſe of arſenic or lead; much leſs with ſome others treated of in the laſt article. The reaſon of this is, that it excites vomiting ſo ſpeedily as to be expelled, even though taken in conſiderable quantity, before it has time to corrode the ſtomach. Roman vitriol, which is a ſolution of copper in the vitriolic acid, has been uſed as a medicine in ſome diſeaſes with great ſucceſs. Verdigriſe alſo, which is another very active preparation of the metal, has been by ſome phyſicians preſcribed as an emetic, eſpecially in caſes where other poiſons had been ſwallowed, in order to procure the moſt ſpeedy evacuation of them by vomit. Where copper is not uſed with this view, it has been employed as a tonic and antiſpaſmodic, with which it has been admitted into the Edinburgh Diſpenſatory under the title of *Cuprum Ammoniacale*. The effects of the metal, however, when taken in a pretty large quantity, and in a diſſolved ſtate, or when the ſtomach abounds with acid juices ſufficient to diſſolve it, are very diſagreeable and even dangerous; as it occaſions violent vomitings, pains in the ſtomach, faintings, and ſometimes convulſions and death. The only cure for theſe ſymptoms is to expel the poiſon by vomiting as ſoon as poſſible, and to obtund its acrimony; for which purpoſe drinking warm milk will probably be found the moſt efficacious remedy. In order to prevent the entrance of the poiſon into the body, no copper veſſels ſhould be uſed in preparing food but ſuch as are either well tinned or kept exceedingly clean. The practice of giving a fine blue or green colour to pickles, by preparing them in copper veſſels, ought not to be tolerated; for Dr Falconer, in a treatiſe on this ſubject, aſſures us, that theſe are ſometimes ſo ſtrongly impregnated by this method of preparing them, that a ſmall quantity of them will produce a ſlight nauſea.——Mortars of braſs or bell-metal ought for the ſame reaſon to be avoided, as by this means a conſiderable quantity of the pernicious metal may be mixed with our food, or with medicines. In other caſes, an equal caution ought to be uſed. The cuſtom of keeping pins in the mouth, of giving copper halfpence to children to play with, &c. ought to be avoided; as thus a quantity of the metal may be inſenſibly taken into the body, after which its effects muſt be uncertain.——It is proper to obſerve, however, that copper is much more eaſily diſſolved when cold than when hot; and therefore the greateſt care ſhould be taken never to let any thing deſigned for food, even common water, remain long in copper veſſels when cold; for it is obſerved, that though the confectioners can ſafely prepare the moſt acid ſyrups in clean copper veſſels without their receiving any detriment whilſt hot, yet if the ſame ſyrups are allowed to remain in the veſſels till quite cold, they become impregnated with the pernicious qualities of the metal.

Poiſon of Lead. See Medicine, n° 303.

Poiſon-Tree. See Rhus.

Poiſon-Tree of Java, called in the Malayan language *bohun upas*, is a tree which has often been deſcribed by naturaliſts; but its exiſtence has been very generally doubted, and the deſcriptions given of it containing much of the marvellous, have been often treated as idle fictions. N. P. Foerſch, however, in an account of it written in Dutch, aſſerts that it does exiſt; and tells us, that he once doubted it as much as any perſon; but, determined not to truſt general opinions, he made the moſt particular inquiries poſſible; the reſult of which was, that he found that it is ſituated in the iſland of Java, about 27 leagues from Batavia, 14 from Soura Charta, the emperor's ſeat, and about 19 from Tinkjoe, the reſidence of the ſultan of Java. It is ſurrounded on all ſides by hills and mountains, and the adjacent country for 12 miles round the tree is totally barren. Our author ſays he has gone all round the ſpot at about 18 miles from the centre, and on all ſides he found the country equally dreary, which he aſcribes to its noxious effluvia. The poiſon procured from it is a gum, iſſuing from between the bark and the tree; and it is brought by malefactors who have been condemned to death, but who are allowed by this alternative to have a chance for their life. An old eccleſiaſtic, our author informs us, dwelt on the outſide of the ſurrounding hills, whoſe buſineſs it was to prepare the criminals for their fate, if death ſhould be the conſequence of their expedition. And indeed ſo fatal is its effluvia, that he acknowledged that ſcarcely two out of 20 returned from above 700 whom he had diſmiſſed.

Mr Foerſch farther tells us, that he had ſeen ſeveral of the criminals who had returned, and who told him, that the tree ſtands on the borders of a rivulet, is of a middling ſize, and that five or ſix young ones of the ſame kind ſtand cloſe to it. They could not, however, ſee any other plant or ſhrub near it; and the ground was of browniſh ſand, full of ſtones and dead bodies, and difficult to paſs. The Malayans think this tract was thus rendered noxious and uninhabitable by the judgement of God, at Mahomet's deſire, on account of the ſins of the inhabitants. No animal whatever is ever ſeen there; and ſuch as get there by any means never return, but have been brought out dead by ſuch of the criminals as have themſelves eſcaped death.

Our author relates a circumſtance which happened in the year 1775, to about 400 families (1600 ſouls), who refuſed to pay ſome duty to the emperor, and who were in conſequence declared rebels and baniſhed: they petitioned for leave to ſettle in the uncultivated parts round Upas: the conſequence of which was, that in leſs than two months their number was reduced to about 300 ſouls, who begged to be reconciled to the emperor, and were again received under his protection. Many of theſe ſurvivors Mr Foerſch ſaw, and they had juſt the appearance of perſons tainted with an infectious diſorder.

With the juice of this tree arrows, lancets, and other offenſive weapons, are poiſoned. With lancets thus poiſoned, Mr Foerſch obſerves, that he ſaw 13 of the emperor's concubines executed for infidelity to his bed in February 1776. They were lanced in the middle of their breaſts; in five minutes after which they were ſeized with a *tremor* and *ſubſultus tendinum*, and in 15 minutes they were dead. Their bodies were full of livid ſpots, like thoſe of *petechiæ*, their faces ſwelled, colour blue, and eyes yellow, &c. Soon after he ſaw ſeven Malayans executed in the ſame way, and ſaw the ſame effects follow; on which he reſolved to try it on other animals, and found the operation ſimilar on three puppies, a cat, and a fowl, none of which ſurvived more than 13 minutes. He alſo tried its effects internally on a dog ſeven months old; the animal became delirious, was ſeized with convulſions, and died in half an hour. From all which our author concludes, that it is the moſt violent of all vegetable poiſons, and that it contributes greatly to the unhealthineſs of the iſland in which it grows. By means of it many cruel and treacherous murders are perpetrated. He adds, that there exiſts a ſort of cajoe-upas on the coaſt of Macaſſar, the poiſon of which, though not near ſo violent or malignant, operates nearly in the ſame manner.

To this account our readers will give ſuch a degree of credit as they think is due; it is our buſineſs however to add, that it has been controverted in all its parts in a memoir of Lambert Nolſt, M.D. fellow of the Batavian Experimental Society at Rotterdam, (ſee Gentleman's Mag. May 1794, p. 433.) This memoir was procured from John Matthew a Rhyn, who had been 23 years, from 1763 to 1786, reſident in the iſland, and therefore had every opportunity of informing himſelf on the ſpot. In this memoir we are told, that Foerſch's account of the tree is extremely ſuſpicious, from a variety of circumſtances: 1. Though he had letters of introduction, he went to no conſiderable houſe, and afterwards privately withdrew among the Engliſh. 2. When the emperor was aſked reſpecting Foerſch, and the facts he relates, he anſwered, that he had never heard either of him or of the tree. 3. The diſtances given to mark the ſituation of the tree are not accurate. 4. The execution of criminals is different from what he repreſents. 5. The circumſtance of ſeveral criminals returning when Foerſch was there has a ſuſpicious appearance. 6. There exiſts no ſuch tradition, as that the tree was placed there by Mahomet. 7. There were no ſuch diſturbances in 1775 as Foerſch repreſents, the tract to which he alludes having ſubmitted to the Dutch Eaſt India Company as early as 1756. 8. The iſland is not unhealthy, as Foerſch aſſerts; nor are violent or premature deaths frequent. 9. The Javaneſe are a curious and intelligent people, and of courſe could not be ſo ignorant of this tree if it had any exiſtence. 10. The aſſertions and pretended facts of Foerſch have no colateral evidence; and every thing which we gather from the accounts of others, or from the hiſtory of the people, invalidates them. For theſe and other reaſons, Dr Nolſt concludes, that very little credit is due to the repreſentations of Foerſch, and that the iſland of Java produces no ſuch tree, which, if it really grew there, would be the moſt remarkable of all trees.

POLA, in ichthyology, is the name of a flat fiſh, reſembling the ſoal, but ſomewhat ſhorter and ſmaller. It is called *cynogloſſus* and *linguatula*. It abounds in the Mediterranean, and is ſold both in Rome and in Venice for the table.

POLACRE, a ſhip with three maſts, uſually navigated in the Levant and other parts of the Mediterranean. Theſe veſſels are generally furniſhed with ſquare ſails upon the main-maſt, and *lateen* ſails upon the fore-maſt and mizen-maſt. Some of them, however, carry ſquare ſails upon all the three maſts, particularly thoſe of Provence in France. Each of their maſts is commonly formed of one piece, ſo that they have neither top maſt nor top-gallant-maſt; neither have they any *horſes* to their yards, becauſe the men ſtand upon the top-ſail-yard to looſe or furl the top-gallant-ſail, and on the lower-yard to *reef*, to looſe, or furl, the top-ſail, whoſe yard is lowered ſufficiently down for that purpoſe.

POLAEDRASTYLA, in natural hiſtory, is the name of a genus of cryſtals, derived from the Greek πολυς, *many*, εδρα, *ſides*, the primitive particle α, *not*, and ϛυλος, a column; and means a cryſtal with many planes, and without a column.

The bodies of this genus are cryſtals of two octangular pyramids, with the baſes joined, the whole body conſiſting of 16 planes. Of this genus there are only two ſpecies known: 1. A brown kind with ſhort pyramids, found in great plenty in Virginia on the ſides of hills; and, 2. A colourleſs one, with longer pyramids. This has yet been found only in one place, which is the great mine at Goſſalaer, in Saxony, where it uſually lies at great depths.

POLAND, a kingdom of Europe, in its largeſt extent bounded by Pomerania, Brandenburg, Sileſia, and Moravia, to the weſt; and, towards the eaſt, by part of Ruſſia and the leſſer Tartary; on the north, it has the Baltic, Ruſſia, the grand province of Livonia, and Samogitia; and on the ſouth, it is bounded by Beſſarabia, Tranſylvania, Moldavia, and Hungary. Geographers generally divide it into the provinces of Poland Proper, Lithuania, Samogitia, Courland, Pruſſia, Maſſovia, Polachia, Poleſia, Little Ruſſia called likewiſe *Ruſſia Rubra* or *Red Ruſſia*, Podolia, and the Ukrain. Now, however, it is very conſiderably reduced in extent, as will appear in the courſe of its hiſtory. For a map of Poland, Lithuania, and Pruſſia, ſee Plate CCCCX.

With regard to the hiſtory of Poland, we are not to gather the earlier part of it from any accounts tranſmitted to us by the natives. The early hiſtories of all nations indeed are involved in fable; but the Poles never had even a fabulous hiſtory of their own nation. The reaſon of this is, that it was not the cuſtom with that nation to entertain itinerant poets for the amuſement of the great; for to the ſongs of theſe poets entertained among other nations we are obliged for the early part of their hiſtory; but this aſſiſtance being deficient in Poland, we muſt have recourſe to what is recorded concerning it by the hiſtorians of other nations.

1 Poliſh ſovereigns at firſt only ſtyled dukes.

The ſovereigns of Poland at firſt had the title of *duces*, dukes or generals, as if their office had been only to lead the armies into the field. The firſt of theſe is univerſally allowed to have been Lechus or Lecht; and to render him more illuſtrious, he is ſaid to have been a lineal deſcendant from Japhet the ſon of Noah. According to ſome writers, he migrated at the head of a numerous body of the deſcendants of the ancient Sclavi from ſome of the neighbouring nations; and, to this day, Poland is called by the Tartars the kingdom of *Lechus*. Buſching, however, gives a different account of the origin of the Poles. Sarmatia, he obſerves, was an extenſive country, inhabited by a variety of nations of different names. He ſuppoſes the Poles to be the deſcendants of the ancient Lazi, a people who lived in Colchis near the Pontus Euxinus; whence the Poles are ſometimes called *Polazi*. Croſſing ſeveral rivers, they entered Poſnania, and ſettled on the borders of the Warta, while their neighbours the Zechi ſettled on the Elbe, in the 550th year of Chriſt. As to the name of *Poland*, or *Polſka*, as it is called by the natives, it comes from the Sclavonic word *Pole*, or *Poln*, which ſignifies a country adapted to hunting, becauſe the whole country was formerly covered with vaſt foreſts, exceedingly proper for that employment.

2 Lechus the firſt duke.

3 Derivation of the different names of Poland.

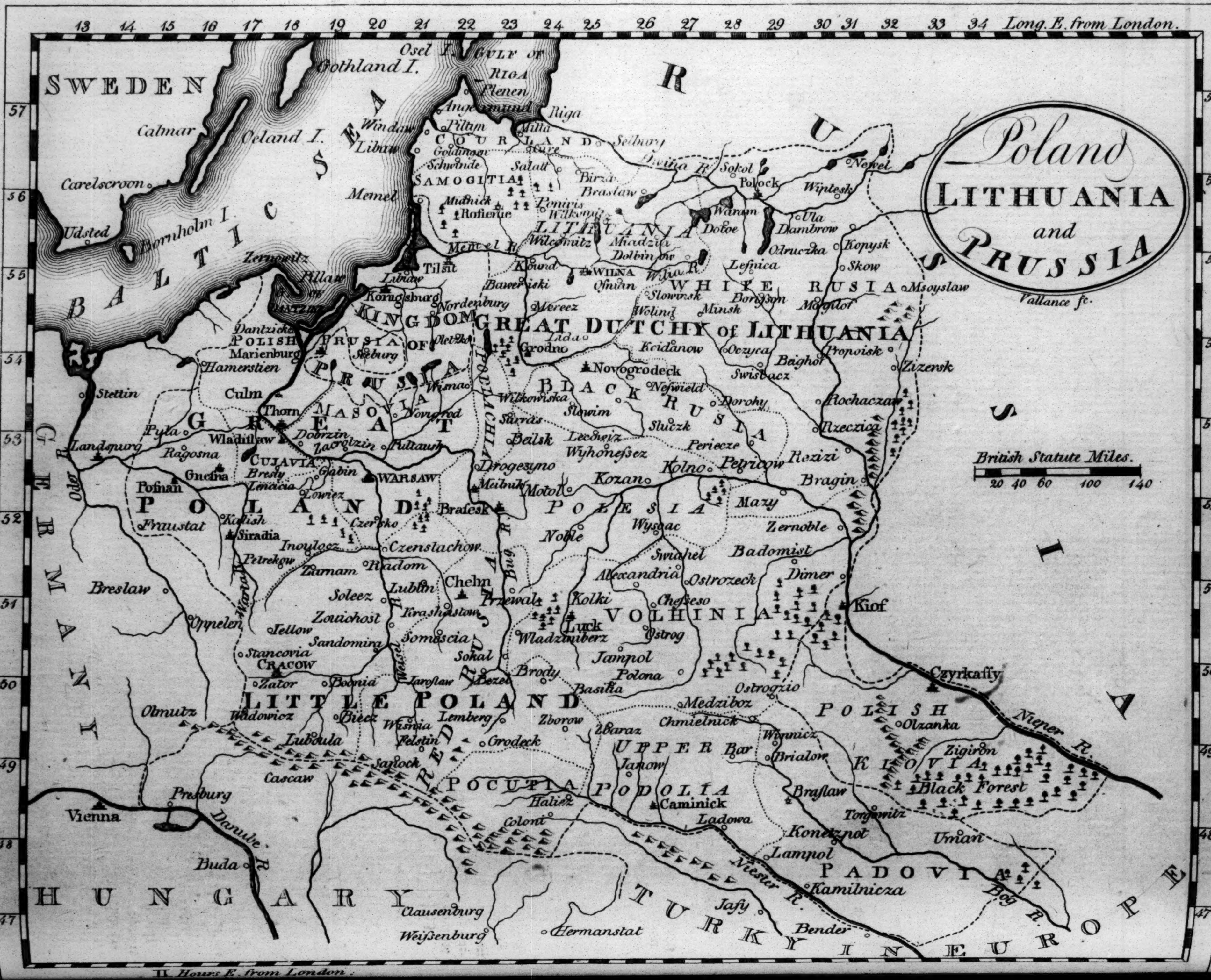
4 Viſcimer the ſecond duke.

Of the tranſactions of Lechus during the time that he enjoyed the ſovereignty, we have no certain account. His ſucceſſor was named *Viſcimer*, who is generally ſuppoſed to have been the nephew of Lechus. He was a warlike and ſucceſsful prince, ſubduing many provinces of Denmark, and building the city of Wiſmar, ſo called from the name of the ſovereign. But the Daniſh hiſtorians take no notice of his wars with their country; nor do they even mention a prince of this name. However, he is ſaid to have reigned for a long time with great glory; but to have left the people in great diſtreſs, on account of the diſputes which aroſe about a ſucceſſor.

5 Form of government changed into ariſtocracy.

After the death of Viſcimer, the nobility were on the point of electing a ſovereign, when the people, haraſſed by the grievous burdens occaſioned by the wars of Viſcimer, unanimouſly demanded another form of government, that they might no longer be liable to ſuffer from ambition and tyranny. At firſt the nobility pretended to yield to this humour of the people with great reluctance; however, they afterwards determined on ſuch a form of government as threw all the power into their own hands. Twelve palatines, or vaivodes, were choſen; and the Poliſh dominions divided into as many provinces. Theſe palatines exerciſed a deſpotic authority within their ſeveral juriſdictions, and aggravated the miſery of the people by perpetual wars among themſelves; upon which the Poles, worn out with oppreſſion, reſolved to return to their old form of government. Many aſſemblies were held for

Plate CCCCX.



Poland
LITHUANIA
and
PRUSSIA

Vallance fc.

Long. E. from London.
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H. Hours E. from London.
British Statute Miles.
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40
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100
140
SWEDEN
BALTIC SEA
Gothland I.
Oeland I.
Calmar
Carelscroon
Udsted
Bornholm I.
Osel I.
GULF OF RIGA
Riga
COURLAND
SAMOGITIA
LITHUANIA
Memel
Tilsit
Konigsburg
Dantzick
POLISH PRUSSIA
Marienburg
KINGDOM OF PRUSSIA
GREAT DUTCHY of LITHUANIA
WHITE RUSIA
BLACK RUSIA
Wilna
Grodno
Novogrodeck
Minsk
Polock
Nevel
MASOVIA
PODLACHIA
CUJAVIA
Warsaw
Thorn
Culm
Stettin
Oder R.
GREAT POLAND
Posnan
Gnesna
Kalish
Siradia
Czenstachow
Radom
Lublin
Chelm
Brzesk
POLESIA
VOLHINIA
Luck
Kiof
Czyrkaffy
Nieper R.
LITTLE POLAND
Cracow
Sandomira
Lemberg
RED RUSSIA
POCUTIA
UPPER PODOLIA
Caminick
POLISH KIOVIA
Black Forest
PADOVIA
Bog R.
Niester R.
Bender
Jassy
GERMANY
Breslaw
Olmutz
Vienna
Presburg
Buda
Danube R.
HUNGARY
Clausenburg
Weißenburg
Hermanstat
TURKY IN EUROPE
RUSSIA

BRITISH MUSEUM

for this purpoſe; but, by reaſon of the oppoſition of the vaivodes, they came to nothing. At laſt, however, they caſt their eyes upon Cracus, or Gracus, whoſe wealth and popularity had raiſed him to the higheſt honours among his countrymen. The Poles ſay that he was a native of Poland, and one of the 12 vaivodes; but the Bohemians affirm that he was a native of their country; however, both agree in maintaining, that he was deſcended from the ancient family of the Gracchi in Rome; who, they ſay, were baniſhed to this country. He is ſaid to have ſignalized himſelf againſt the Franks, whom he overthrew in ſome deſperate engagements, and afterwards built the city of Cracow with their ſpoils. He did not enlarge his dominions, but made his ſubjects happy by many excellent regulations. At laſt, after a long and glorious reign, he expired, or, according to ſome, was aſſaſſinated by a nobleman who aſpired to the crown.

6 The dukedom reſtored.

Cracus left three children; Cracus, Lechus, and a daughter named *Vanda*. The firſt ſucceeded to the dukedom in virtue of his birthright; but was ſoon after murdered by his brother Lechus. However, it ſeems the thoughts of the crime which he had committed, ſo diſturbed his conſcience, that the ſecret could not be kept. When it was known that he had been the murderer of his late ſovereign, he was depoſed with all poſſible marks of ignominy and contempt, and his ſiſter Vanda declared ducheſs. She was a moſt beautiful and accompliſhed lady; and ſoon after ſhe had been raiſed to the ſovereignty, one Rithogar, a Teutonic prince, ſent an ambaſſador demanding her in marriage, and threatening war if his propoſals were refuſed. Vanda marched in perſon againſt him at the head of a numerous army, and the event proved fatal both to Rithogar and herſelf. The troops of Rithogar abandoned him without ſtriking a blow, upon which he killed himſelf in deſpair; and Vanda, having become enamoured of him, was ſo much concerned for his death, that ſhe drowned herſelf in the river Viſtula or Weſel. From this unfortunate lady the country of Vandalia takes its name.

7 Again aboliſhed.

The family of Cracus having become extinct by the death of Vanda, the Poles were again left at liberty to chooſe a new ſovereign or a new form of goverment. Through a natural levity, they changed the form of goverment, and reſtored the vaivodes notwithſtanding all that they had formerly ſuffered from them. The conſequences were the ſame as before: the vaivodes abuſed their power; the people were oppreſſed, and the ſtate was diſtracted between foreign wars and civil contentions. At that time the Hungarians and Moravians had invaded Poland with a numerous army, and were oppoſed only by a handful of men almoſt ready to ſurrender at diſcretion. However, one Premiſlaus, a private ſoldier, contrived a ſtratagem by which the numerous forces of the enemy were overthrown; and for his valour was rewarded with the dukedom. We are ignorant of the other tranſactions of his reign; but all hiſtorians inform us that he died deeply regretted, and without iſſue; ſo that the Poles had once more to chooſe a ſovereign.

8 Reſtored a ſecond time.

On the death of Premiſlaus ſeveral candidates appeared for the throne; and the Poles determined to prefer him who could overcome all his competitors in a horſe-race. A ſtone pillar was erected near the capital, on which were laid all the enſigns of the ducal authority; and an herald proclaimed, that he who firſt arrived at that pillar from a river at ſome diſtance, named *Pouderic*, was to enjoy them. A Poliſh lord named *Lechus* was reſolved to ſecure the victory to himſelf by a ſtratagem; for which purpoſe he cauſed iron ſpikes to be driven all over the courſe reſerving only a path for his own horſe. The fraudulent deſign took effect in part, all the reſt of the competitors being diſmounted, and ſome ſeverely hurt by their fall. Lechus, in conſequence of this victory, was about to be proclaimed duke; when, unluckily for him, a peaſant who had found out the artifice oppoſed the ceremony; and upon an examination of the fact, Lechus was torn in pieces, and the ducal authority conferred upon the peaſant.

The name of the new monarch was alſo Lechus. He attained the ſovereignty in the year 774, and behaved with great wiſdom and moderation. Though he poſſeſſed the qualities of a great warrior, and extended his dominions on the ſide of Moravia and Bohemia, yet his chief delight was to make his ſubjects happy by peace. In the decline of life he was obliged to engage in a war with Charlemagne, and is ſaid by ſome to have fallen in battle with that powerful monarch; though others aſſert that he died a natural death, having lived ſo long that the ſprings of life were quite worn out.

Lechus III. was ſucceeded by his ſon Lechus IV. who inherited all his father's virtues. He ſuppreſſed an inſurrection in the Poliſh provinces, by which he acquired great reputation; after which he led his army againſt the Greek and Italian legions who had overrun Panonia. He gained a complete victory over his enemies. Nor was his valour more conſpicuous in the battle than his clemency to the vanquiſhed: for he diſmiſſed all his priſoners without ranſom; demanding no other conditions than that they ſhould never again diſturb the peace of Poland, or the allies of that kingdom. This duke is ſaid to have been endowed with many virtues, and is charged only with the vice of incontinence. He left 20 natural children, and only one legitimate ſon, named *Popiel*, to whom he left the ſovereignty. Popiel was alſo a virtuous and pacific prince, who never had recourſe to arms but through neceſſity. He removed the ſeat of government from Cracow to Gneſna, and was ſucceeded by his nephew Popiel II. a minor.

The young king behaved with propriety as long as he was under the tuition of others; but as ſoon as he had got the reins of government into his own hands the face of affairs was altered. Lechus III. who as hath been already mentioned, had 20 illegitimate children, had promoted them to the government of different provinces; and they had diſcharged the duties of their offices in ſuch a manner as ſhowed that they were worthy of the confidence repoſed in them. However, as ſoon as Popiel came of age, being ſeduced by the advice of his wife, an artful and ambitious woman, he removed them from their poſts, treated them with the utmoſt contempt, and at laſt found means to poiſon them all at once at an entertainment. A dreadful puniſhment, however, according to the hiſtorians of thoſe times, attended his treachery and cruelty. The bodies of the unhappy governors were left unburied; and from them iſſued a ſwarm of rats, who purſued Popiel, his wife, and children, wherever they went, and at laſt devoured them. The nation now became a prey to civil diſcord at the ſame time that it was haraſſed by a foreign enemy; and, in ſhort, the ſtate ſeemed to be on the verge of diſſolution, when Piaſtus was proclaimed duke in 830, from whom the natives of ducal or regal dignity were called *Piaſtes*. See PIASTUS.

9 Why the ſovereigns of Poland are called Piaſtes.

This excellent monarch died in 861, and was ſucceeded by his ſon Ziemovitus, who was of a more warlike diſpoſition than his father, and who firſt introduced a regular diſcipline among the Poliſh troops. He maintained a reſpectable army, and took great pains to acquire a perfect knowledge of the art of war. The conſequence of this was, that he was victorious in all his battles; and retook from the Germans and Hungarians not only all that they had gained, but enlarged his dominions beyond what they had been. After his death nothing remarkable happened in Poland till the time of Mieczſlaus I. who attained the ducal authority in 964. He was born blind, and continued ſo for ſeven years: after which he recovered his ſight without uſing any medicine; a circumſtance ſo extraordinary, that in thoſe times of ignorance and ſuperſtition it was accounted a miracle.

10 Chriſtianity introduced by Mieczſlaus I.

In his reign the Chriſtian religion was introduced into Poland. The moſt probable account of the manner in which Chriſtianity was introduced is, that Mieczſlaus having by ambaſſadors made his addreſſes to Daborwka daughter to the duke of Bohemia, the lady rejected his offer unleſs he would ſuffer himſelf to be baptized. To this the duke conſented, and was baptized, after having been inſtructed in the principles of Chriſtianity. He founded the archbiſhoprics of Gneſna and Cracow; and appointed St Adalbert, ſent by the pontiff to propagate Chriſtianity in Poland, primate of the whole kingdom. On the birth of his ſon Boleſlaus he redoubled his zeal; founding ſeveral biſhoprics and monaſteries; ordering likewiſe that, when any part of the Goſpel was read, the hearers ſhould half draw their ſwords, in teſtimony of their readineſs to defend the faith. He was, however, too ſuperſtitious to attend to the duties of a ſovereign; and ſuffered his dominions to be ravaged by his barbarous neighbour the duke of Ruſſia. Yet, with all his devotion, he could not obtain the title of king from the pope, though he had warmly ſolicited it; but it was afterwards conferred on his ſon, who ſucceeded to all his dominions.

11 Boleſlaus the firſt king of Poland.

Boleſlaus I. the firſt king of Poland, ſurnamed *Chrobry* ſucceeded to the ſovereignty in 999. He alſo profeſſed and cheriſhed Chriſtianity, and was a man of great valour and prudence. However, the firſt tranſaction of his reign ſavoured very much of the ridiculous piety of thoſe times. He removed from Prague to Gneſna the remains of a ſaint which he had purchaſed at a conſiderable price. The emperor Otho III. made a pilgrimage, on account of a vow to the tomb of this ſaint. He was hoſpitably received by Boleſlaus, whom, in return, he inveſted with the regal dignity; an act which was confirmed by the pope. This new dignity added nothing to the power of Boleſlaus; though it increaſed his conſequence with his own ſubjects. He now affected more ſtate than before: his body guards were conſiderably augmented; and he was conſtantly attended by a numerous and ſplendid retinue whenever he ſtirred out of his palace. Thus he inſpired his people with an idea of his greatneſs, and conſequently of their own importance; which no doubt was neceſſary for the accompliſhment of a deſign he had formed, namely, an offenſive war with Ruſſia: but when he was upon the point of ſetting out on this expedition, he was prevented by the breaking out of a war with the Bohemians. The elevation of Boleſlaus to the regal dignity had excited the envy of the duke of Bohemia, who had ſolicited the ſame honour for himſelf, and had been refuſed. His jealouſy was further excited by the connection between Boleſlaus and the emperor, the former having married Rixa the emperor's niece. Without any provocation, therefore, or without giving the leaſt intimation of his deſign, the duke of Bohemia entered Poland at the head of a numerous army, committing everywhere dreadful ravages.

12 He conquers Bohemia.

Boleſlaus immediately marched againſt him, and the Bohemians retired with precipitation. Scarcity of proviſions, and the inclemency of the ſeaſon, prevented Boleſlaus at the time from purſuing; but as ſoon as theſe obſtacles were removed, he entered Bohemia at the head of a formidable army, with a full reſolution of taking an ample revenge. The Bohemians were altogether unable to reſiſt; neither indeed had they courage to venture a battle, though Boleſlaus did all in his power to force them to it. So great indeed was the cowardice of the duke or his army, that they ſuffered Prague, the capital of the duchy, to be taken after a ſiege of two years; having never, during all that time, ventured to relieve it by fighting the Poliſh army. The taking of this city was quickly followed by the reduction of all the places of inferior note: but though Boleſlaus was in poſſeſſion of almoſt all the fortified places in Bohemia, he could not believe his conqueſts to be complete until he became maſter of the duke's perſon. This unfortunate prince had ſhut himſelf up with his ſon in his only remaining fortreſs of Wiſſogrod, where he imagined that he ſhould be able to foil all the attempts of the Poliſh monarch. In this, however, he found himſelf diſappointed. Boleſlaus inveſted the place, and made his approaches with ſuch rapidity, that the garriſon, dreading a general aſſault, reſolved to capitulate, and perſiſted in their reſolution notwithſtanding all the intreaties and promiſes of the duke. The conſequence was, that the unhappy prince fell into the hands of his enemies, and had his eyes put out by Boleſlaus; after which, his ſon Jaremir was put into perpetual and cloſe confinement.

13 And Moravia.

From Bohemia Boleſlaus marched towards Moravia; but no ſooner did he arrive on the frontier than the whole province ſubmitted without a blow. He then reſumed his intention of invading Ruſſia; for which he had now a very fair opportunity, by reaſon of a civil war which raged with violence among the children of duke Volodomir. The chief competitors were Jariſlaus and Suantepolk. The latter having been defeated by his brother, was obliged to take refuge in Poland, where he uſed all the arguments in his power with king Boleſlaus in order to induce him to revenge his cauſe. Boleſlaus having already an intention of invading that country, needed but little intreaty; and therefore moved towards Ruſſia at the head of a very numerous army: giving out that he had no other deſign than to revenge the injuſtice done to Suantepolk. He was met on the banks of the river Bog by Jariſlaus at the head of an army much ſuperior in number to his own; and for ſome days the Poliſh army was kept at bay by the Ruſſians.

14 Gains a great victory over the Ruſſians.

At laſt Boleſlaus, growing impatient, reſolved to paſs the river at all events; and therefore forming his cavalry in the beſt manner for breaking the torrent, he expoſed his own perſon to the utmoſt of its force. Encouraged by his example, the Poles advanced breaſt-high in the water to the oppoſite ſhore; from whence they gave the enemy all the annoyance in their power. In ſpite of all oppoſition, however, the Poles reached the bank, and ſoon gained a complete victory, Jariſlaus being obliged to fly to Kiovia. This city was immediately inveſted; but Jariſlaus retired farther into the country in order to recruit his army, leaving the city to its fate. The garriſon made a brave defence, but were at laſt compelled to ſurrender at diſcretion. A vaſt treaſure was found in the place; great part of which was diſtributed by Boleſlaus among the ſoldiers.

15 Places Suantepolk on the throne of Ruſſia,

Though the king of Poland had now become maſter of the greateſt part of Ruſſia, he knew that the only poſſible means of keeping the country in ſubjection was by placing a natural ſovereign over the inhabitants. For this reaſon he reinſtated Sauntepolk, though his pretenſions were ſtill diſputed by Jariſlaus. The latter had formed a flying camp, and meditated a ſcheme of ſurpriſing and carrying off his rival brother; but having failed in this attempt, he retired to Novogorod, where the attachment of the inhabitants enabled him to make ſome reſtance, till at laſt he was attacked and defeated by Boleſlaus, which ſeemed to give the finiſhing ſtroke to his affairs.

16 Who attempts to cut him off with his whole army but is defeated.

The king of Poland, however, now met with a more dangerous enemy in the perfidious and ungrateful Suantepolk than he had experienced in Jariſlaus. The Ruſſian prince, imagining himſelf a dependent on Boleſlaus, formed a conſpiracy againſt him; by which he projected nothing leſs than the deſtruction of him and his whole army. The maſſacre was already begun when Boleſlaus received intelligence. The urgency of the caſe admitted of no delay: the king therefore mounted his horſe; and having with the utmoſt haſte aſſembled part of his army, fell upon the traitors with ſuch fury, that they were obliged to betake themſelves to flight, and Boleſlaus got ſafe into Poland.

17 A dreadful battle between the Ruſſians and Poles.

But in the mean time Jariſlaus having aſſembled freſh forces, purſued the Poliſh army; and having come up with them juſt as one half had croſſed the river Boriſthenes, attacked them with the utmoſt fury. Boleſlaus defended himſelf with the greateſt reſolution; but, by reaſon of his forces being divided, victory was dubious for a long time. At laſt, when the army had wholly croſſed, the Ruſſians were entirely put to the rout, and a terrible carnage enſued. The victory, however, though complete, was not deciſive; for which reaſon Boleſlaus thought proper to continue his retreat, without attempting to conquer a country too extenſive for him ever to keep in ſubjection.

18 Saxony conquered by Boleſlaus,

Still, however, his martial inclination continued, and he led his army into Saxony. The inhabitants of this country had hitherto reſiſted all attempts that had been made on their freedom, and ſtill made a violent ſtruggle for liberty; though in ſpite of their utmoſt efforts, they were obliged at laſt to ſubmit to the yoke. On his withdrawing the troops from Saxony, however, the king thought proper to leave the people to their liberty, contenting himſelf with a rich booty. The boundaries of his empire he now fixed at the river Elbe; where he erected two iron columns, in order to tranſmit the memory of his conqueſt to poſterity.

Boleſlaus, ſtill unſated with victory, now meditated the conqueſt of Pruſſia and Pomerania; the latter of which provinces had, in the former civil wars, been diſmembered from Poland.

19 With Pruſſia and Pomerania.

His arms were attended with equal ſucceſs againſt both: indeed the very terror of his name ſeemed to anſwer all the purpoſes of a formidable army. Theſe, however, he ſeems to have deſigned to be the laſt of his warlike enterpriſes; for he now applied himſelf wholly to the enacting of wholeſome laws for the benefit of his people. But in the midſt of this tranquillity Jariſlaus aſſembled the moſt numerous army that had ever been heard of in Ruſſia, with which he appeared on the frontiers of Poland.

20 Gains another great victory over the Ruſſians, on which the whole country ſubmits.

Boleſlaus, though now advanced in years, marched out againſt his adverſaries, and met them on the banks of the Boriſthenes, rendered famous by the victory he had lately gained there. The Poles croſſed the river by ſwimming; and attacked the enemy before they had time to draw up in order of battle with ſuch impetuoſity, that a total rout ſoon enſued. The Ruſſians were ſeized with a panic, and Jariſlaus was hurried away and almoſt trampled to death by the fugitives. Many thouſand priſoners were taken, but Boleſlaus releaſed them upon very eaſy conditions; contenting himſelf with an inconſiderable tribute, and endeavouring to engage the affections of the people by his kindneſs. This well timed clemency produced ſuch an happy effect, that the Ruſſians voluntarily ſubmitted to his juriſdiction, and again became his ſubjects.

21 Boleſlaus dies.

Soon after this he died in the year 1025, after having vaſtly extended his dominions, and rendered his ſubjects happy.

Boleſlaus was ſucceeded by his ſon Mieczſlaus II. but he poſſeſſed none of the great qualities of his father, being indolent and debauched in his behaviour. In the very beginning of his reign, the Ruſſians, Bohemians, and Moravians, revolted. However, as the ſpirit and diſcipline introduced by Boleſlaus ſtill remained in the Poliſh army, Mieczſlaus found no great difficulty in reducing them again to obedience: after which, devoting himſelf entirely to voluptuouſneſs, he was ſeized with a frenzy, which put an end to his life in the year 1034.

22 Rixa, a tyrannical regent, driven out with her ſon Caſimir.

The bad qualities of this prince proved very detrimental to the intereſt of his ſon Caſimir; though the latter had received an exellent education, and was poſſeſſed of many virtues. Inſtead of electing him king, they choſe Rixa his mother queen-regent. She proved tyrannical, and ſo partial to her countrymen the Germans, that a rebellion enſued, and ſhe was forced to fly to Germany; where ſhe obtained the protection of the emperor by means of the immenſe treaſures of Boleſlaus, which ſhe had cauſed to be tranſported thither before her. Her bad behaviour and expulſion proved ſtill more fatal to the affairs of Caſimir than even that of his father. He was immediately driven out of the kingdom; and a civil war taking place, a great many pretenders to the crown appeared at once.

23 Poland diſtreſſed by foreign and domeſtic wars.

To the miſeries occaſioned by this were added thoſe of a foreign war; for the Bohemians and Ruſſians invaded the kingdom in different places, committing the moſt dreadful ravages. The conſequence of theſe accumulated diſtreſſes was, that the nobility come at laſt to the reſolution of recalling Caſimir, and electing him ſovereign. However, before they took this meaſure, it was thought proper to ſend to Rome to complain of the behaviour of the duke of Bohemia. The deputies were at firſt received favourably;

but the influence of the duke's gold prevailing, no redreſs was obtained; ſo that at laſt it was reſolved, without more ado, to ſend for Caſimir.

24
Caſimir recalled and elected king.

25
Poland ſubjected to the tax called Peter-pence.

The only difficulty was where to find the fugitive prince; for he had been gone five years from the kingdom, and nobody knew the place of his retreat. At laſt, by ſending an embaſſy to his mother, it was found out that he had retired into France, where he applied cloſely to ſtudy at the univerſity of Paris. Afterwards he went to Italy; where, for the ſake of ſubſiſtence, he took upon him the monaſtic habit. At that time he had returned to France, and obtained ſome preferment in the abbey of Clugni. Nothing now obſtructed the prince's return but the ſacred function with which he was inveſted. However, a diſpenſation was obtained from the pope, by which he was releaſed from his eccleſiaſtical engagements, on condition that he and all the kingdom ſhould become ſubject to the capitation tax called *Peter-pence*. Some other conditions of leſs conſequence were added; ſuch as, that the Poles ſhould ſhave their heads and beards, and wear a white linen robe at feſtivals, like other profeſſors of the Catholic religion. Great preparations were made for the reception of the young prince: and he was met on the frontier by the nobility, clergy, and forces of the nation; by whom he was conducted to Gneſna, and crowned by the primate with more than uſual ſolemnity. He proved a virtuous and pacific prince, as indeed the diſtracted ſituation of the kingdom would not admit of the carrying on of wars. However, Caſimir proved his courage in ſubduing the banditti by which the country was over-run; and by marrying the princeſs Mary, ſiſter to the duke of Ruſſia, all quarrels with that nation were for the preſent extinguiſhed. Upon the whole, the kingdom flouriſhed during his reign; and became more reſpectable from the wiſdom and ſtability of the adminiſtration than it could have been by many victories. After a happy reign of 16 years, he died beloved and regretted by all his ſubjects.

26
Boleſlaus II. a valiant and ſucceſsful prince.

27
Entertains three unfortunate princes.

28
Affords effectual ſuccour to Jacomir prince of Bohemia.

By the happy adminiſtration of Caſimir the kingdom recovered ſufficient ſtrength to carry on ſucceſsful wars againſt its foreign enemies. Boleſlaus II. the ſon of Caſimir, an enterpriſing and valiant prince, ſucceeded to the throne; and ſoon made himſelf ſo famous, that three unfortunate princes all took refuge at his court at once, having been expelled from their own dominions by their rebellious ſubjects. Theſe were, Jacomir, ſon of Briteſlaus duke of Bohemia; Bela, brother to the king of Hungary; and Zaſlaus duke of Kiovia, eldeſt ſon to Jeriſlaus duke of Ruſſia, and couſin to the king of Poland. Boleſlaus determined to redreſs all their grievances; but while he deliberated upon the moſt proper means for ſo doing, the duke of Bohemia, dreading the conſequence of Jacomir's eſcape, aſſembled an army, and without any declaration of war, marched through the Hercynian foreſt, deſolated Sileſia, and laid waſte the frontiers of Poland with fire and ſword. Boleſlaus marched againſt him with a force greatly inferior; and, by mere dint of ſuperior capacity, cooped up his adverſary in a wood, where he reduced him to the greateſt diſtreſs. In this extremity the duke ſent propoſals for accommodation; but they were rejected with diſdain by Boleſlaus; upon which the former, ordering fires to be kindled in his camp, as if he deſigned to continue there, removed with the utmoſt ſilence in the night-time; and marching through narrow defiles, was advanced ſeveral leagues before Boleſlaus received advice of his retreat. The king purſued him, but in vain; for which reaſon he returned, after having ravaged the frontiers of Moravia. The next year he entered Bohemia with a numerous army; but the duke, being unwilling to encounter ſuch a formidable adverſary, ſubmitted to ſuch terms as Boleſlaus thought proper to impoſe. In theſe the king of Poland ſtipulated for certain conditions in favour of Jacomir, which he took care to ſee punctually executed; after which he determined to march towards Hungary, to aſſiſt the fugitive prince Bela.

29
And to Bela prince of Hungary.

This prince had been for ſome time ſolicited by a party of diſaffected nobility to return, as his brother, the reigning king, had alienated the hearts of his ſubjects by his tyrannical behaviour: as ſoon therefore as Boleſlaus had finiſhed the war in Bohemia, he was ſolicited by Bela to embrace ſo favourable an opportunity, and put him in poſſeſſion of the kingdom of Hungary. This the king readily complied with, as being agreeable to his own inclinations; and both princes entered Hungary by different routes, each at the head of a numerous body. The king of that country, however, was not diſconcerted by ſuch a formidable invaſion; and being largely aſſiſted by the emperor, advanced againſt his antagoniſts with a vaſt army; among whom was a numerous body of Bohemians, who had come to his aſſiſtance, though in direct violation of the treaty ſubſiſting between the duke and the king of Poland. At laſt a deciſive battle was fought, in which the Germans behaved with the greateſt valour, but were entirely defeated through the treachery of the Hungarians, who in the heat of the battle deſerted and went over to Bela. Almoſt all the foreign auxiliaries were killed on the ſpot; the king himſelf was ſeized, and treated with ſuch inſolence by his perfidious ſubjects, that he died in a ſhort time of a broken heart; ſo that Bela was placed on the throne without further oppoſition, except from a revolt of the peaſants, which was ſoon quelled by the Poliſh army.

30
He projects the conqueſt of Ruſſia.

31
Meets with ſurpriſing ſucceſs.

Boleſlaus, having ſucceeded ſo happily in theſe two enterpriſes, began to look upon himſelf as invincible; and, inſtead of deſigning only to aſſiſt Zaſlaus, as he had firſt intended, now projected no leſs than the ſubjection of the whole country. He had indeed a claim to the ſovereignty by virtue of his deſcent from Mary, queen of Poland, ſiſter to Jariſlaus; and this he endeavoured to ſtrengthen by marrying a Ruſſian princeſs himſelf. Having therefore aſſembled a very numerous and well-diſciplined army, he entered the duchy of Kiovia, where he was oppoſed by Wiſſeſlaus, who had uſurped the ſovereignty with a vaſt multitude of forces. Boleſlaus, however, continued to advance; and the Ruſſian prince being intimidated by the number and good order of his enemies, deſerted his own troops, and fled away privately with a ſlender retinue; upon which his force diſperſed themſelves for want of a leader. The inhabitants of the city of Kiovia now called to their aſſiſtance Suantoſlaus and Wſzevold two brothers of Wiſſeſlaus; but theſe princes acting the part of mediators, procured pardon for the inhabitants from Zaſlaus their natural ſovereign. With the ſame facility the two princes recovered all the other dominions belonging to Zaſlaus; only one city venturing to ſtand a ſiege, and that was ſoon reduced. But in the mean time the king of Hungary dying, a revolt enſued, and the two ſons of Bela were on the point of being deprived of their paternal dominions. This Boleſlaus no ſooner heard than he marched directly into Hungary; where by the bare terror of his name, he re-eſtabliſhed tranquillity, and confirmed the princes in the enjoyment of their kingdom. In the time that this was doing, Zaſlaus was again driven from his territories, all the conqueſts that had been formerly made were loſt, and Suantoſlaus and Wſzevold more powerful than ever. The king's vigour, however, ſoon diſconcerted all their meaſures. He ravaged all thoſe territories which compoſed the palatinates of Luſac and Chelm, reduced the ſtrong city of Wolyn, and tranſported the booty to Poland. The campaign was finiſhed by a battle with Wſzevold; which proved ſo bloody, that though Boleſlaus was victorious, his army was weakened in ſuch a manner that he could not purſue his conqueſts. In the winter he made numerous levies; and returning in the ſpring to Kiovia, reduced it, after ſeveral deſperate attacks, by famine. On this occaſion, inſtead of treating the inhabitants with cruelty, he commended their valour, and ſtrictly prohibited his troops from pillaging or inſulting them; diſtributing proviſions among them with the utmoſt liberality.

32
Reduces Kiovia, but enervates himſelf there.

33
Univerſal defection of the Poliſh women.

This clemency procured the higheſt honour to the king of Poland; but his ſtay here produced a moſt terrible diſaſter. Kiovia was the moſt diſſolute, as well as the richeſt city, in the north; the king and all his ſoldiers gave themſelves up to the pleaſures of the place. Boleſlaus himſelf affected all the imperious ſtate of an eaſtern monarch, and contracted an inclination for the groſſeſt debaucheries. The conſequence had almoſt proved fatal to Poland. The Hungarian and Ruſſian wars had continued for ſeven years, during all which time the king had never been at home excepting once for the ſhort ſpace of three months. In the mean time the Poliſh women, exaſperated at hearing that their huſbands had neglected them and connected themſelves with the women of Kiovia raiſed their ſlaves to the beds of their maſters; and in ſhort the whole ſex conſpired in one general ſcheme of proſtitution, in order to be revenged of the infidelity of their huſbands, excepting one ſingle woman, namely, *Margaret*, the wife of count Nicholas of Demboiſin, who preſerved her fidelity in ſpite of all ſolicitation. Advice of this ſtrange revolution was ſoon received at Kiovia, where it excited terrible commotions. The ſoldiers blamed the king for their diſhonour; forgetting how much they had to accuſe their own conduct in giving their wives ſuch extreme provocation. The effect of theſe diſcontents was a general deſertion, and Boleſlaus ſaw himſelf ſuddenly left almoſt alone in the heart of Ruſſia; the ſoldiers having unanimouſly reſolved to return home to take vengeance of their wives and their gallants.

34
A terrible civil war enſues.

A dreadful kind of war now enſued. The women knew that they were to expect no mercy from their enraged huſbands, and therefore perſuaded their lovers to take arms in their defence. They themſelves fought by the ſide of their gallants with the utmoſt fury and ſought out their huſbands in the heat of battle, in order to ſecure themſelves from all danger of puniſhment by their death. They were, however, on the point of being ſubdued, when Boleſlaus arrived with the few remaining Poles, but aſſiſted by a vaſt army of Ruſſians, with whom he intended to take equal vengeance on the women, their gallants, and his own ſoldiers who had deſerted him. This produced a carnage more dreadful than ever. The ſoldiers united with their former wives and their gallants againſt the common enemy, and fought againſt Boleſlaus and his Ruſſians with the fury of lions. At laſt, however, the fortune of the king prevailed; the rebels were totally ſubdued, and the few who eſcaped the ſword were tortured to death, or died in priſon.

35
Religious contentions.

36
Boleſlaus depoſed by the pope, and the whole kingdom put under an interdict.

To add to the calamities of this unhappy kingdom, the ſchiſms which for ſome time had prevailed in the church of Rome found their way into Poland alſo; and the animoſity of parties became aggravated in proportion to the frivolouſneſs of their differences. By perverſe accident the matter came at laſt to be a contention for wealth and power between the king and clergy. This ſoon gave occaſion to bloodſhed; and the biſhop of Cracow was maſſacred in the cathedral while he was performing the duties of his office. This and ſome other enormous crimes in a ſhort time brought on the moſt ſignal vengeance of the clergy. Gregory VII. the pope at that time, thundered out the moſt dreadful anathemas againſt the king, releaſed his ſubjects from their allegiance, deprived him of the titles of ſovereignty, and laid the kingdom under a general interdict, which the archbiſhop of Gneſna ſaw punctually enforced. To this terrible ſentence Boleſlaus in vain oppoſed his authority and recalled the ſpirit which had formerly rendered him ſo formidable to the neighbouring ſtates. The minds of the people were blinded by ſuperſtition, ſo that they deemed it a leſs heinous crime to riſe in rebellion againſt their ſovereign than to oppoſe the tyranny of the holy ſee. Conſpiracies were daily formed againſt the perſon and government of Boleſlaus. The whole kingdom became a ſcene of confuſion, ſo that the king could no longer continue with ſafety in his own dominions. He fled therefore with his ſon Mieczſlaus, and took refuge in Hungary; but here alſo the holy vengeance of the clergy purſued him, nor did they ceaſe perſecuting him till he was brought to a miſerable end. Authors differ widely with reſpect to the manner of his death. Some ſay that he was murdered by the clergy as he was hunting; others, that he killed himſelf in a fit of deſpair; and one author tells us hat he wandered about in the woods of Hungary, lived like a ſavage upon wild beaſts, and was at laſt killed and devoured by dogs. The greateſt number, however, tell us, that being driven from place to place by the perſecutions of the clergy, he was at laſt obliged to become a cook in a monaſtery at Carinthia, in which mean occupation he ended his days.

37
The king's extreme diſtreſs and death.

38
The interdict removed at the expence of grievous impoſitions.

The deſtruction of Boleſlaus was not ſufficient to allay the papal reſentment. It extended to the whole kingdom of Poland. Mieczſlaus, the ſon of Boleſlaus, was not ſuffered to aſcend the throne; and the kingdom continued under the moſt ſevere interdict, which could be removed only by the force of gold, and the moſt abject conceſſions. Beſides the tax called *Peter-pence*, new impoſitions were added of the moſt oppreſſive nature; till at length the pontiff, having ſatiated his avarice, and impoveriſhed the country, conſented that the brother of the deceaſed monarch ſhould be raiſed to the ſovereignty, but only with the title of duke. This prince, named *Uladiſlaus*, being of a meek diſpoſition, 39 Uladiſlaus becomes ſovereign, but is allowed only the title of duke.

with little ambition, thought it his duty to acquieſce implicitly in the will of the pope; and therefore accepted the terms offered, ſending at the ſame time an embaſſy to Rome, earneſtly intreating the removal of the interdict. The requeſt was granted; but all his endeavours to recover the regal dignity proved fruitleſs, the pope having, in conjunction with the emperor of Germany, conferred that honour on the duke of Bohemia. This was extremely mortifying to Uladiſlaus, but it was abſorbed in conſiderations of the utmoſt conſequence to himſelf and his dominions. Ruſſia took the opportunity of the late civil diſturbances to throw off the yoke; and this revolt drew after it the revolt of Pruſſia, Pomerania, and other provinces. The ſmaller provinces, however, were ſoon reduced; but the duke had no ſooner returned to Poland, than they again rebelled, and hid their families in impenetrable foreſts. Uladiſlaus marched againſt them with a conſiderable army; but was entirely defeated, and obliged to return back with diſgrace. Next year, however, he had better fortune; and, having led againſt them a more numerous army than before, they were content to ſubmit and deliver up the ringleaders of the revolt to be puniſhed as the duke thought proper.

No ſooner were the Pomeranians reduced, than civil diſſenſions took place. Sbigneus, the ſon of Uladiſlaus by a concubine, was placed at the head of an army by the diſcontented nobility, in order to ſubvert his father's government, and diſpute the title of Boleſlaus, the legitimate ſon of Uladiſlaus, to the ſucceſſion. The war was terminated by the defeat and captivity of Sbigneus; who was at firſt confined, but afterwards releaſed on condition that he ſhould join his father in puniſhing the palatine of Cracow. But before this could be done, the palatine found means to effect a reconciliation with the duke; with which the young princes being diſpleaſed, a war took place between them and their father. The end of all was, that the palatine of Cracow was baniſhed, and the princes ſubmitted; after which, Uladiſlaus, having chaſtiſed the Pruſſians and Pomeranians who had again revolted, died in the year 1103, the 59th of his age.

40 Boleſlaus III. divided his dominions betwixt Sbigneus his illegitimate brother and himſelf.

41 A civil war.

42 Generoſity of Boleſlaus, and ingratitude of Sbigneus.

Uladiſlaus was ſucceeded by his ſon Boleſlaus III. who divided the dominions equally betwixt his brother Sbigneus and himſelf. The former being diſſatisfied with his ſhare raiſed cabals againſt his brother. A civil war was for ſome time prevented by the good offices of the primate: but at laſt Sbigneus, having privately ſtirred up the Bohemians, Saxons, and Moravians, againſt his brother, made ſuch formidable preparations as threatened the conqueſt of all Poland. Boleſlaus, being unprovided with forces to oppoſe ſuch a formidable power, had recourſe to the Ruſſians and Hungarians; who readily embraced his cauſe, in expectation of turning it to their own advantage. The event was, that Sbigneus was entirely defeated; and might eaſily have been obliged to ſurrender himſelf at diſcretion, had not Boleſlaus generouſly left him in quiet poſſeſſion of the duchy of Mazovia, in order to maintain himſelf ſuitably to the dignity of his birth. This kindneſs the ungrateful Sbigneus repaid by entering into another conſpiracy; but the plot being diſcovered, he was ſeized, baniſhed, and declared a traitor if ever he ſet foot again in Poland. Even this ſeverity did not produce the deſired effect: Sbigneus perſuaded the Pomeranians to arm in his behalf; but he was defeated, taken priſoner, and again baniſhed. Almoſt all the nobility ſolicited the king to put ſuch an ungrateful traitor to death; however, that generous prince could not think of polluting his hands with the death of his brother, notwithſtanding all he had yet done. Nay, he even took him back to Poland, and appointed him a maintenance ſuitable to his rank: but he ſoon had reaſon to repent his kindneſs; for his unnatural brother in a ſhort time began to raiſe freſh diſturbances, in conſequence of which he ſoon met with the death which he deſerved.

43 Who is at laſt put to death.

44 War with the emperor Henry IV.

Boleſlaus was ſcarce freed from the intrigues of his brother, when he found himſelf in greater danger than ever from the ambition of the emperor Henry IV. The emperor had attacked the king of Hungary, with whom Boleſlaus was in cloſe alliance, and from whom he had received aſſiſtance when in great diſtreſs himſelf. The king of Poland determined to aſſiſt his friend; and therefore made a powerful diverſion in Bohemia, where he repeatedly defeated the Imperialiſts: upon which, the emperor collecting all his forces, ravaged Sileſia, and even entered Poland, where he laid ſiege to the ſtrong town of Lubuſz; but was at laſt obliged to abandon the enterpriſe, after having ſuſtained much loſs. However, Henry was not diſcouraged, but penetrated ſtill farther into Poland, and was laying waſte all before him, when the ſuperior ſkill of Boleſlaus compelled him to retire, after having almoſt deſtroyed his army with fatigue and famine, without once coming to action. Enraged at this diſappointment, Henry laid ſiege to Glogaw, in hopes of drawing the Poles to an engagement before he ſhould be obliged to evacuate the country. The fortifications of the place were weak; but the ſpirit of the inhabitants ſupplied their deficiencies, and they gave the Imperialiſts a moſt unexpected and vigorous reception. At laſt, however, they were on the point of ſurrendering to ſuperior force; and actually agreed to give up the place, provided they did not receive any ſuccours during that time. Boleſlaus determined, however, not to let ſuch a brave garriſon fall a ſacrifice to their loyalty; and therefore prevailed on the beſieged to break the capitulation rather than ſurrender when they were on the point of being delivered. All this was tranſacted with the utmoſt ſecrecy; ſo that the emperor advanced without thoughts of meeting with any reſiſtance, to take poſſeſſion of the city; but, being received by a furious diſcharge of arrows and javelins, he was ſo incenſed, that he reſolved to ſtorm the place, and give no quarter. On the approach of the army, the Imperialiſts were aſtoniſhed to ſee not only the breaches filled up, but new walls, ſecured by a wet ditch, reared behind the old, and erected during the ſuſpenſion of hoſtilities by the induſtry of the beſieged. The attack however, went on; but the inhabitants animated by deſpair, defended themſelves with incredible valour, and at laſt obliged the Imperialiſts to break up the ſiege with precipitation. Next day Boleſlaus arrived, and purſued the emperor with ſuch vigour, that he obliged him to fly with diſgrace into his own country. This ſoon brought on a peace, which was confirmed by a marriage between Boleſlaus and the emperor's ſiſter.

45 Who is worſted.

46 Boleſlaus brought into difficulties by his own credulity and generoſity.

Hitherto the glory of Boleſlaus had equalled, or even eclipſed, that of his nameſake and predeceſſor Boleſlaus the Great; but about the year 1135 he was brought into difficulties and diſgrace by his own credulity. He was impoſed upon by an artful ſtory patched up by a certain Hungarian; who inſinuated himſelf ſo far into his affections, that he gave him the government of Wiſlica, a ſtrong town on the river Nida. But the traitor gave up the place to the Ruſſians, who pillaged and burnt it; carrying the inhabitants at the ſame time into ſlavery. Boleſlaus was incenſed, and entered immediately upon a war with Ruſſia, by which means he only heaped one calamity upon another. He received a deputation from the inhabitants of Halitz, to implore his aſſiſtance in favour of a young prince, who had been baniſhed into Poland. Boleſlaus marched to their relief with a choice body of troops; but as he was preparing to enter the town, he was attacked by the whole Ruſſian army, and, after a moſt violent conflict, entirely defeated. By this diſgrace the duke was ſo much afflicted, that he died in a ſhort time, after having reigned 36 years.

47
Poland divided among the children of Boleſlaus.

Boleſlaus, by his will, left his dominions equally divided among his four ſons. Uladiſlaus, the eldeſt, had the provinces of Cracow, Sirad, Lencici, Sileſia, and Pomerania. Boleſlaus, the ſecond ſon, had for his ſhare the palatinates of Culm and Cujava, with the duchy of Mazovia. The palatinates of Kaleſzh and Poſnania fell to Mieczſlaus the third ſon; and to Henry, the fourth ſon, were aſſigned thoſe of Lublin, and Sandomir. Caſimir the youngeſt child, then an infant in the cradle, was entirely forgot, and no proviſion made for him. There have been but very few inſtances where dominions were thus divided, that the princes remained ſatisfied with their reſpective ſhares; neither did the ſons of Boleſlaus long continue at peace with one another. By the will of the late duke, all the brothers were obliged to own the ſupremacy of Uladiſlaus, who was declared duke of all Poland: they were reſtrained from forming alliances, declaring war, or concluding peace, without his approbation: they were obliged to take the field with a certain number of troops, whenever the duke required it; and they were forbid to meddle with the guardianſhip of the infant prince Caſimir, his education being left entirely to the ſovereign. The harmony of the princes was firſt diſturbed by the ambition of Chriſtina, the wife of Uladiſlaus, who formed a ſcheme to get poſſeſſion of all Poland, and deprive the younger children of the benefit of their father's will. Having obtained her huſband's concurrence, ſhe aſſembled the ſtates of Poland, and made a long ſpeech, ſhowing the dangers which might ariſe from a partition of the ducal dominions among ſo many; and concluded with attempting to ſhow the neceſſity of revoking the ratification of the late duke's will, in order to enſure the obedience of the princes and the tranquillity of the republic. Many of the nobility expreſſed their reſentment againſt this ſpeech, and fully refuted every article in it; but they were all afterwards gained over, or intimidated by Uladiſlaus; ſo that none appeared to take the part of the young princes except a noble Dane, who loſt his life for ſo doing.

48
A civil war.

49
Uladiſlaus drives out all the reſt.

Uladiſlaus now having got the nobility on his ſide, firſt drove Boleſlaus out of his territories; next, he marched againſt Henry, and diſpoſſeſſed him alſo, forcing both to take refuge with Mieczſlaus in Poſnania, where all the three brothers were beſieged. Several of the nobility interpoſed, and uſed all their influence to effect a reconciliation, but in vain; for Uladiſlaus was as inexorable as if he had received an injury, and therefore inſiſted that the beſieged princes ſhould ſurrender at diſcretion, and ſubmit to the will of the conqueror. Thus driven to deſpair, the brothers ſallied out, and attacked the duke's army with ſuch impetuoſity, that they obtained a complete victory, and took all his baggage and valuable effects. The brothers improved their victory, and laid ſiege to Cracow. The Ruſſians, who had aſſiſted Uladiſlaus at firſt, now entirely abandoned him, and evacuated Poland, which obliged him to ſhut himſelf up in Cracow; but, finding the inhabitants little diſpoſed to ſtand a ſiege, he retired into Germany in order to ſolicit aſſiſtance from his wife's friends. But here he found himſelf miſtaken, and that theſe friends were attached to him only in his proſperity; while in the mean time the city of Cracow ſurrendered, the unfortunate Uladiſlaus was formally depoſed, and his brother Boleſlaus raiſed to the ſupreme authority.

50
And is depoſed.

The new duke began his adminiſtration with an act of generoſity to his brother Uladiſlaus, to whom he gave the duchy of Sileſia, which was thus ſeparated from Poland, and has never ſince been re-annexed to it. This had no other effect upon Uladiſlaus than the putting him in a condition to raiſe freſh diſturbances; for he now found means to perſuade the emperor Conrade to invade Poland: but Boleſlaus ſo haraſſed and fatigued his army by perpetual marches, ambuſcades, and ſkirmiſhes, that he was obliged in a ſhort time to return to his own country; and for ſome years Poland enjoyed a profound tranquillity.

During this interval Henry entered on a cruſade; and, though he loſt almoſt all his army in that enthuſiaſtic undertaking, he is celebrated by the ſuperſtitious writers of that age, as the bulwark of the church, and one of the greateſt Chriſtian heroes: however, in all probability, the reaſon of this extraordinary fame is, that he made large donations to the knights of St John of Jeruſalem. Soon after the return of Henry, Poland was invaded by the emperor Frederic Barbaroſſa, who was perſuaded to this by the ſolicitations of Uladiſlaus and his wife Chriſtina. The number of the Imperialiſts was ſo great, that Boleſlaus and his brothers did not think proper to oppoſe them in the field; they contented themſelves with cutting off the convoys, placing ambuſcades, haraſſing them on their march, and keeping them in perpetual alarms by falſe attacks and ſkirmiſhes. With this view the three brothers divided their forces, deſolated the country before the enemy, and burnt all the towns and cities which were in no condition to ſtand a ſiege. Thus the emperor advancing into the heart of a deſolated country where he could not ſubſiſt, was at laſt reduced to ſuch a ſituation that he could neither go forward nor retreat, and was obliged to ſolicit a conference with Boleſlaus. The latter was too prudent to irritate him by an unſeaſonable haughtineſs, and therefore went to the German camp attended only by his brothers and a ſlight guard. This inſtance of confidence was ſo agreeable to the emperor, that a treaty was ſoon agreed upon, which was confirmed by a marriage between Adelaide, niece to the emperor, and Mieczſlaus duke of Poſnania.

51
Poland invaded by the emperor Barbaroſſa.

52
Who is obliged to ſue for peace.

Boleſlaus having thus happily eſcaped from ſo great a danger, took it into his head to attempt the conqueſt of Pruſſia, for no other reaſon but becauſe the inhabitants were heathens. Having unexpectedly invaded the country with a very numerous army, he ſucceeded in his enterpriſe; great numbers of infidels were converted, and many churches ſet up: but no ſooner was Boleſlaus gone, than the inhabitants returned to their old religion. Upon this Boleſlaus again came againſt them with a formidable power; but, being betrayed by ſome Pruſſians whom he had taken into his ſervice and raiſed to poſts of honour, his army was led into defiles and almoſt entirely cut off, duke Henry was killed, and Boleſlaus and Mieczſlaus eſcaped with great difficulty.

53 A civil war,

This misfortune was quickly followed by another; for now the children of Uladiſlaus laid claim to all the Poliſh dominions which had been poſſeſſed by their father, moſt of which had been beſtowed upon young Caſimir. They were ſupported in their pretenſions by a great number of diſcontented Poles, and a conſiderable body of German auxiliaries. Boleſlaus, finding himſelf unable to withſtand his enemies by force, had recourſe to negociation, by which means he gained time to recruit his army and repair his loſſes. An aſſembly of the ſtates was held, before which the duke ſo fully refuted the claims of the children of Uladiſlaus, that it was almoſt unanimouſly voted that they had kindled an unjuſt war; and to take away every pretence for renewing the civil diſcords of Poland, they were a ſecond time inveſted with the duchy of Sileſia, which for the preſent put an end to all diſputes. After this, Boleſlaus applied himſelf to promote, by all means, the happineſs of his ſubjects, till his death, which happened in the year 1174.

On the death of Boleſlaus, the ſtates raiſed his brother Mieczſlaus to the ducal throne, on account of the great opinion they had of him. But the moment that Mieczſlaus ceaſed to be a ſubject, he became a tyrant, and a ſlave to almoſt every kind of vice; the conſequence of which was, that in a very ſhort time he was depoſed and his brother Caſimir elected in his ſtead.

54 Caſimir, an excellent prince,

Caſimir was a prince of the greateſt juſtice and benevolence, inſomuch that he ſcrupled to accept of the honour which the ſtates had conferred upon him, leſt it ſhould be a treſpaſs againſt the laws of equity. However, this ſcruple being ſoon got over, he ſet himſelf about the ſecuring peace and tranquillity in all parts of his dominions. He redreſſed all grievances, ſuppreſſed exorbitant impoſts, and aſſembled a general diet, in which it was propoſed to reſcue the peaſants from the tyranny of the nobility; an affair of ſuch conſequence, that the duke could not enter upon it by his own authority, even though ſupported by the clergy. Yet it proved leſs difficult than had been imagined, to perſuade the nobility to relinquiſh certain privileges extremely detrimental to natural right. They were influenced by the example of their virtuous ſovereign, and immediately granted all that he required; and, to ſecure this declaration in favour of the peaſants, the archbiſhop of Gneſna thundered out anathemas againſt thoſe who ſhould endeavour to regain the unjuſt privileges which they had now renounced; and to give a ſtill greater weight to this deciſion, the acts of the diet were tranſmitted to Rome, where they were confirmed by the pope.

But though the nobility in general conſented to have their power ſomewhat retrenched, it proved matter of diſcontent to ſome, who for this reaſon immediately became the partiſans of the depoſed Mieczſlaus. This unfortunate prince was now reduced to ſuch indigence, that he wrote an account of his ſituation to his brother Caſimir; which ſo much affected him, that in an aſſembly of the diet he propoſed to reſign the ſovereignty in favour of his brother. To this the ſtates replied in the moſt peremptory manner: they deſired him never more to mention the ſubject to them, leſt they ſhould be under the neceſſity of depoſing him and excluding his brother, who, they were determined, ſhould never more have the dominion of Poland. Caſimir, however, was ſo much concerned at the account of his brother's misfortunes, that he tried every method to relieve him, and even connived at the arts practiſed by ſome diſcontented noblemen to reſtore him. By a very ſingular generoſity, he facilitated the reduction of Gneſna and Lower Poland, where Mieczſlaus might have lived in peace and ſplendor, had not his heart been ſo corrupted that it could not be ſubdued by kindneſs. The conſequence was, that he uſed all his art to wreſt from his brother the whole of his dominions, and actually conquered the provinces of Mizovia and Cujava; but of theſe he was ſoon diſpoſſeſſed, and only ſome places in Lower Poland were left him. After this he made another attempt, on occaſion of a report that Caſimir had been poiſoned in an expedition into Ruſſia. He ſurpriſed the city of Cracow: but the citadel refuſed to ſurrender, and his hopes were entirely blaſted by the return of Caſimir himſelf; who, with an unparalleled generoſity and magnanimity, aſked peace of his brother whom he had vanquiſhed and had in a manner at his mercy.—The laſt action of this amiable prince was the conqueſt of Ruſſia, which he effected rather by the reputation of his wiſdom and generoſity than by the force of his arms. Thoſe barbarians voluntarily ſubmitted to a prince ſo famed for his benevolence, juſtice, and humanity. Soon after his return, he died at Cracow, lamented as the beſt prince in every reſpect who had ever filled the throne of Poland.

55 Conquers Ruſſia.

Caſimir left one ſon, named *Lechus*, an infant; and the ſtates, dreading the conſequences of a long minority, heſitated at appointing him ſovereign, conſidering how many competitors he muſt neceſſarily have, and how dubious it muſt be whether he might be fit for the ſovereignty after he had obtained it. At laſt, however, Lechus was nominated, chiefly through the intereſt he had obtained on account of the reputation of his father's virtues. The conſequence of his nomination was preciſely what might have been expected. Mieczſlaus formed an alliance againſt him with the dukes of Oppelen, Pomerania, and Breſlau; and having raiſed all the men in Lower Poland fit to bear arms, took the road to Cracow with a very numerous army. A bloody battle was fought on the banks of the river Mozgarva; in which both ſides were ſo much weakened, that they were unable to keep the field, and conſequently were forced to retire for ſome time in order to repair their forces. Mieczſlaus was firſt ready for action, and therefore had the advantage: however, he thought proper to employ artifice rather than open force; and therefore having attempted in vain to corrupt the guardians of Lechus, he entered into a treaty with the ducheſs-dowager his mother. To her he repreſented in the ſtrongeſt manner the miſeries which would enſue from her refuſal of the conditions he propoſed. He ſtipulated to adopt Lechus and Conrade, her ſons, for his own; to ſurrender

56 Civil war between Lechus and the depoſed Mieczſlaus.

57 Mieczſlaus reſtored.

ſurrender the province of Cujavia for their preſent ſupport; and to declare them heirs to all his dominions. The principal nobility oppoſed this accommodation, but it was accepted by the ducheſs in ſpite of all their remonſtrances; and Mieczſlaus was once more put in poſſeſſion of the capital, after having taken a ſolemn oath to execute punctually every article of the treaty.

It is not to be ſuppoſed that a prince of ſuch a perfidious diſpoſition at Mieczſlaus would pay much regard to the obligations of a ſimple contract. It was a maxim with him, that a ſovereign is no longer obliged to keep his oath than while it is neither ſafe nor benefical to break it. Having therefore got all the power into his hands, he behaved in the very ſame manner as if no treaty with the ducheſs had ſubſiſted. The ducheſs, perceiving herſelf duped, formed a ſtrong party, and excited a general inſurrection. The rebellion could not be withſtood: Mieczſlaus was driven out of Cracow, and on the point of being reduced to his former circumſtances, when he found means to produce a variance between the ducheſs and palatine of Cracow; and thus once more turned the ſcale in his favour. The forces of Mieczſlaus now became ſuperior, and he, in conſequence, regained poſſeſſion of Cracow, but did not long enjoy his proſperity, falling a victim to his intemperance; ſo that Lechus was reſtored to the ſovereignty in the year 1206.

58 Poland ravaged by the Tartars.

The government of Lechus was the moſt unfortunate of any of the Sovereigns of Poland. In this time the Tartars made an irruption, and committed everywhere the moſt cruel ravages. At laſt they came to an engagement with the Poles, aſſiſted by the Ruſſians; and after an obſtinate and dreadful conflict, obtained a complete victory. This incurſion, however, terminated as precipitately as it commenced; for without any apparent reaſon they retired, juſt as the whole kingdom was ready to ſubmit; but the devaſtations they had committed produced a famine, which was ſoon followed by a plague that depopulated one of the moſt populous countries of the north. In this unhappy ſituation of affairs, death ended the misfortunes of Lechus, who was murdered by his own ſubjects as he was bathing. A civil war took place after his death; and the hiſtory for ſome time is ſo confuſed, that it is difficult to ſay with certainty who was his ſucceſſor. During this unfortunate ſtate of the country, the Tartars made a ſecond irruption, laid all deſolate before them, and were advancing to the capital, when they were attacked and defeated with great ſlaughter by the palatine of Cracow with only a handful of men. The power of the enemy, however, was not broken by this victory; for, next year, the Tartars returned, and committed ſuch barbarities as can ſcarce be imagined. Whole provinces were defeated, and every one of the inhabitants maſſacred. They were returning, laden with ſpoil, when the palatine fell upon them a ſecond time, but not with the ſame ſucceſs as before: for, after an obſtinate engagement, he was defeated, and thus all Poland was laid open to the ravages of the barbarians; the nobility fled into Hungary, and the peaſants ſought an aſylum among rocks and impenetrable foreſts. Cracow, being left entirely defenceleſs, was ſoon taken, pillaged, and burnt; after which the barbarians, penetrating into Sileſia and Moravia, deſolated theſe countries, deſtroying Breſlau and other cities. Nor did Hungary eſcape the fury of their barbarity; the king gave battle to the Tartars, but was defeated with vaſt ſlaughter, and had the mortification to ſee his capital laid in aſhes, and above 100,000 of his ſubjects periſh by fire and ſword. The arms of the Tartars were invincible; nothing could withſtand the prodigious number of forces which they brought into the field, and the fury with which they fought. They fixed their head-quarters on the frontiers of Hungary; and ſpread their devaſtations on every ſide with a celerity and ſucceſs that threatened the deſtruction of the whole empire, as well as of the neighbouring kingdoms.

In this dreadful ſituation was Poland when Boleſlaus, ſurnamed the *Chaſte*, was raiſed to the ſovereignty; but this, ſo far from putting an end to the troubles, only ſuperadded a civil war to the reſt of the calamities. Boleſlaus was oppoſed by his uncle Conrade the brother of Lechus, who was provoked at becoming the ſubject of his own nephew. Having aſſembled a powerful army, he gained poſſeſſion of Cracow; aſſumed the title of *Duke of Poland;* and might poſſibly have kept poſſeſſion of the ſovereignty, had not his avarice and pride equally offended the nobility and peaſants. In conſequence of their diſcontents, they unanimouſly invited Boleſlaus, who had fled into Hungary, to come and head the inſurrection which now took place in every quarter. On his arrival, he was joyfully received into the capital: but Conrade ſtill headed a powerful party; and it is reported that on this occaſion the kinghts of the Teutonic order were firſt called into Poland, to diſpute the pretenſions of Boleſlaus. All the endeavours of Conrade, however, proved unſucceſsful: he was defeated in two pitched battles, and forced to live in a private ſituation; though he never ceaſed to haraſs his nephew, and make freſh attempts to recover the crown. However, of the reign of Boleſlaus we have little account, except that he made a vow of perpetual continency, and impoſed the ſame on his wife; that he founded near 40 monaſteries; and that he died after a long reign in 1279, after having adopted Lechus duke of Cujavia, and procured a confirmation of his choice by the free election of the people.

59 Knights of the Teutonic order firſt called into Poland.

60 Poland over-run by the Ruſſians, Tartars, and Lithuanians.

The reign of this laſt prince was one continued ſcene of foreign and domeſtic trouble. On his firſt acceſſion he was attacked by the united forces of Ruſſia and Lithuania aſſiſted by the Tartars; whom, however, he had the good fortune to defeat in a pitched battle. By this victory the enemy were obliged to quit the kingdom; but Lechus was ſo much weakened, that civil diſſenſions took place immediately after. Theſe increaſed to ſuch a degree, that Lechus was obliged to fly to Hungary, the common reſource of diſtreſſed Poliſh princes. The inhabitants of Cracow alone remained firm in their duty; and theſe brave citizens ſtood all the fatigue and danger of a tedious ſiege, till they were at laſt relieved by Lechus at the head of an Hungarian army, who defeated the rebels, and reſtored to his kingdom a legitimate government. He had ſcarce reaſcended the throne when the united forces of the Ruſſians, Tartars, and Lithuanians, made a ſecond irruption into Poland, and deſolated the country with the moſt ſavage barbarity. Their forces were now rendered more terrible than ever by their having along with them a vaſt number of large dogs trained to the art of war. Lechus, however, with an army much inferior, obtained a complete

61 War with the Teutonic knights

victory; the Poles being animated by deſpair, as perceiving, that, if they were conquered, they muſt alſo be devoured. Soon after this, Lechus died with the reputation of a warlike, wiſe, but unfortunate prince. As he died without iſſue, his crown was conteſted, a civil war again enſued; and the affairs of the ſtate continued in a very declining way till the year 1296, when Premiſlaus, the duke at that time, reſumed the title of *king*. However, they did not revive in any conſiderable degree till the year 1305, when Uladiſlaus Locticus, who had ſeized the throne in 1300, and afterwards been driven out, was again reſtored to it. The firſt tranſaction of his reign was a war with the Teutonic knights, who had uſurped the greater part of Pomerania during the late diſturbances. They had been ſettled in the territory of Culm by Conrade duke of Mazovia; but ſoon extended their dominion over the neighbouring provinces, and had even got poſſeſſion of the city of Dantzic, where they maſſacred a number of Pomeranian gentlemen in cold blood; which ſo much terrified the neighbouring towns, that they ſubmitted without a ſtroke. The knights were commanded by the Pope himſelf to renounce their conqueſts; but they ſet at nought all his thunders, and even ſuffered themſelves to be excommunicated rather than part with them. As ſoon as this happened, the king marched into the territories of the marquis of Brandenburg, becauſe he had pretended to ſell a right to the Teutonic knights to thoſe countries, when he had none to them himſelf. Uladiſlaus next entered the territory of Culm, where he laid every thing waſte with fire and ſword; and, being oppoſed by the joint forces of the marquis, the knights, and the duke of Mazovia, he obtained a complete victory after a deſperate and bloody engagement. Without purſuing the blow, he returned to Poland, recruited his army, and being reinforced by a body of auxiliaries from Hungary and Lithuania, he diſperſed the enemy's forces, and ravaged a ſecond time all the dominions of the Teutonic order. Had he improved this advantage, he might eaſily have exterminated the whole order, or at leaſt reduced them ſo low, that they could never have occaſioned any more diſturbances in the ſtate; but he ſuffered himſelf to be ſoothed and cajoled by the promiſes which they made without any deſign of keeping them, and concluded a treaty under the mediation of the kings of Hungary and Bohemia. In a few months he was convinced of the perfidy of the knights; for they not only refuſed to evacuate Pomerania as had been ſtipulated in the treaty, but endeavoured to extend their uſurpations, for which purpoſe they had aſſembled a very conſiderable army. Uladiſlaus, enraged at their treachery, took the field a third time, and gave them battle with ſuch ſucceſs, that 4000 knights were left dead on the ſpot, and 30,000 auxiliaries killed or taken priſoners. Yet, though the king had it once more in his power to deſtroy the whole Teutonic order, he ſatisfied himſelf with obtaining the territories which had occaſioned the war; after which he ſpent the remainder of his life in peace and tranquillity.

62 Ruſſia Nigra conquered by Caſimir the Great.

Uladiſlaus was ſucceeded by his ſon Caſimir III. ſurnamed the *Great*. He ſubdued the province called *Ruſſia Nigra* in a ſingle campaign. Next he turned his arms againſt Mazovia; and with the utmoſt rapidity over-ran the duchy, and annexed it as a province to the crown: after which he applied himſelf to domeſtic affairs, and was the firſt who introduced a written code of laws into Poland. He was the moſt impartial judge, the moſt rigid obſerver of juſtice, and the moſt ſubmiſſive to the laws, of any potentate mentioned in the hiſtory of Europe. The only vice with which he is charged is that of incontinency; but even this the clergy declared to be a venial ſin, and amply compenſated by his other virtues, particularly the great liberality which he ſhowed to the clerical order.

63 Unhappy reign of Louis.

Caſimir was ſucceeded in 1370 by his nephew Louis king of Hungary; but, as the Poles looked upon him to be a foreign prince, they were not happy under his adminiſtration. Indeed a coldneſs between this monarch and his people took place even before he aſcended the throne for in the *pacta conventa*, to which the Poliſh monarchs were obliged to ſwear, a great number of unuſual articles were inſerted. This probably was the reaſon why he left Poland almoſt as ſoon as his coronation was over, carrying with him the crown, ſceptre, globe, and ſword of ſtate, to prevent the Poles from electing another prince during his abſence. He left the government in the hands of his mother Elizabeth; and ſhe would have been agreeable to the people, had her capacity for government been equal to the taſk. At that time, however, the ſtate of Poland was too much diſtracted to be governed by a woman. The country was over-run with bold robbers and gangs of villains, who committed the moſt horrid diſorders; the kingdom was likewiſe invaded by the Lithuanians; the whole province of Ruſſia Nigra revolted; and the kingdom was univerſally filled with diſſenſion. The Poles could not bear to ſee their towns filled with Hungarian garriſons; and therefore ſent a meſſage to the king, telling him that they thought he had been ſufficiently honoured in being elected king of Poland himſelf, without ſuffering the kingdom to be governed by a woman and his Hungarian ſubjects. On this Louis immediately raiſed a numerous army, with a deſign fully to conquer the ſpirit of his ſubjects. His firſt operations were directed againſt the Ruſſians; whom he defeated, and again reduced to ſubjection. Then he turned his arms againſt the Lithuanians, drove them out of the kingdom, and re-eſtabliſhed public tranquillity. However, inſtead of being ſatisfied with this, and removing the Hungarian garriſons, he introduced many more, and raiſed Hungarians to all the chief poſts of government. His credit and authority even went ſo far as to get a ſucceſſor nominated who was diſagreeable to the whole nation, namely *Sigiſmund* marquis of Brandenburg. After the death of Louis, however, this election was ſet aſide; and Hedwiga, daughter of Caſimir the Great, was proclaimed queen.

64 Hedwiga marries the duke of Lithuania, thereby uniting that duchy, together with Samogitia and Ruſſia Nigra to Poland.

This princeſs married Jagello duke of Lithuania, who was now converted to Chriſtianity, and baptized by the name of *Uladiſlaus*. In conſequence of this marriage, the duchy of Lithuania, as well as the vaſt provinces of Samogitia and Ruſſia Nigra, became annexed to the crown of Poland. Such a formidable acceſſion of power excited the jealouſy of the Teutonic knights, who were ſenſible that Uladiſlaus was now bound to undertake the reduction of Pomerania, and revenge all the injuries which Poland had ſuſtained from them for a great number of years. From his firſt acceſſion therefore they conſidered this monarch as their greateſt enemy, and endeavoured to prevent his deſigns againſt them by effecting

ing a revolution in Lithuania in favour of his brother Andrew. The proſpect of ſucceſs was the greater here, as moſt of the nobility were diſcontented with the late alliance, and Uladiſlaus had propoſed to effect a revolution in religion, which was highly diſagreeable. On a ſudden, therefore, two armies marched towards the frontiers of the duchy, which they as ſuddenly penetrated, laying waſte the whole country, and ſeizing upon ſome important fortreſſes before the king of Poland had any notice of the matter. As ſoon as he received advice of theſe ravages, Uladiſlaus raiſed ſome forces with the utmoſt celerity, which he committed to the care of his brother Skirgello, who defeated the Teutonic knights, and ſoon obliged them to abandon all their conqueſts. In the mean time Uladiſlaus marched in perſon into the Higher Poland, which was ſubjected to a variety of petty tyrants, who oppreſſed the people, and governed with intolerable deſpotiſm. The palatine of Poſnia in particular had diſtinguiſhed himſelf by his rebellious practices; but he was completely defeated by Uladiſlaus, and the whole country reduced to obedience.

65
Troubles in Lithuania.

Having ſecured the tranquillity of Poland, Uladiſlaus viſited Lithuania, attended by a great number of the clergy, in order to convert his ſubjects. This he effected without great difficulty; but left the care of the duchy to his brother Skirgello, a man of a cruel, haughty, and debauched turn, and who immediately began to abuſe his power. With him the king ſent his couſin Vitowda, a prince of a generous, brave, and amiable diſpoſition, to be a check upon his conduct; but the barbarity of Skirgello ſoon obliged this prince to take refuge among the Teutonic knights, who were now become the aſylum of the oppreſſed and diſcontented. For ſome time, however, he did not aſſiſt the knights in their deſigns againſt his country; but having applied for protection to the king, and finding him remiſs in affording the neceſſary aſſiſtance, he at laſt joined in the ſchemes formed by the knights for the deſtruction of Poland. Entering Lithuania at the head of a numerous army, he took the capital, burnt part of it, and deſtroyed 14,000 perſons in the flames, beſides a great number who were maſſacred in attempting to make their eſcape. The upper part of the city, however, was vigorouſly defended, ſo that the beſiegers were at laſt obliged to abandon all thoughts of making themſelves maſters of it, and to content themſelves with deſolating the adjacent country. The next year Vitowda renewed his attempts upon this city, but with the ſame ill ſucceſs; though he got poſſeſſion of ſome places of leſs note. As ſoon, however, as an opportunity offered, he came to an accommodation with the king, who beſtowed on him the government of Lithuania. During the firſt years of his government, he beſtowed the moſt diligent attention upon domeſtic affairs, endeavouring to repair the calamities which the late wars had occaſioned; but his impetuous valour prompted him at laſt to engage in a war with Tamerlane the Great, after his victory over Bajazet the Turkiſh emperor. For ſome time before, Vitowda had been at war with the neighbouring Tartars, and had been conſtantly victorious, tranſporting whole hordes of that barbarous people into Poland and Lithuania, where to this day they form a colony diſtinct in manners and dreſs from the other inhabitants. Uladiſlaus, however, diſſuaded him from attacking the whole ſtrength of the nation under ſuch a celebrated commander as Tamerlane: but Vitowda was obſtinate; he encountered an army of 400,000 Tartars under Ediga, Tamerlane's lieutenant, with only a tenth part of their number. The battle continued for a whole day; but at laſt Vitowda was ſurrounded by the numbers of his enemy, and in the utmoſt danger of being cut in pieces. However, he broke his way through with prodigious ſlaughter on both ſides; and came off at laſt without a total defeat, having killed a number of the enemy equal to the whole of his own army.

66
Terrible battle with the Tartars.

67
Wars with the Teutonic knights

During the abſence of Vitowda, the Teutonic knights had penetrated into Lithuania, committing everywhere the moſt dreadful ravages. On his return he attacked and defeated them, making an irruption into Livonia, to puniſh the inhabitants of that country for the aſſiſtance they had given to the Teutonic order. This was ſucceeded by a long ſeries of wars between Poland and Pruſſia, in which it became neceſſary for Uladiſlaus himſelf to take the field. The knights had now one way or other got poſſeſſion of Samogitia, Mazovia, Culm, Sileſia, and Pomerania; ſo that Uladiſlaus reſolved to puniſh them before they became too powerful. With this view he aſſembled an army compoſed of ſeveral different nations, with which he penetrated into Pruſſia, took ſeveral towns, and was advancing to Marienburg the capital of Pomerania, when he was met by the army of the Pruſſian knights, who determined to hazard a battle. When the engagement began, the Poles were deſerted by all their auxiliaries, and obliged to ſtand the brunt of the battle by themſelves. But the courage and conduct of their king ſo animated them, that after a moſt deſperate battle they obtained a complete victory; near 40,000 of the enemy being killed in the field, and 30,000 taken priſoners. This terrible overthrow, however, was leſs fatal to the affairs of the Pruſſian knights than might have been expected; as Uladiſlaus did not improve his victory, and a peace was concluded upon eaſier terms than his adverſaries had any reaſon to expect.—Some infraction of the treaty occaſioned a renewal of hoſtilities; and Uladiſlaus was ſo much elated with victory that he would hearken to no terms, by which means the enemy were driven to the deſperate reſolution of burying themſelves in the ruins of their capital. The ſiege was accordingly commenced, and both ſides behaved with the greateſt vigour; but at laſt, through the good conduct and valour of the grand maſter of the knights named *Plawen*, the Poliſh monarch found himſelf obliged to grant them an advantageous peace, at a time when it was univerſally expected that the whole order would have been exterminated.

Uladiſlaus V. died in 1435, and was ſucceeded by his ſon Uladiſlaus VI. at that time only nine years of age. He had ſcarce aſcended the throne, when the kingdom was invaded by the Tartars, who defeated Buccarius the general of the Poliſh forces; and committing everywhere dreadful ravages, returned to their own country loaded with booty. A few years after, the nation was involved in a war with Amurath the emperor of the Turks, who threatened to break into Hungary; and it was thought by the diet to be good policy to aſſiſt the Hungarians at this juncture, becauſe it was impoſſible to know where the ſtorm might fall after Hungary was conquered. But before all things were prepared for the young king to take the field, a ſtrong body of auxiliaries were diſpatched under the celebrated John Hunniades vaivode of Tranſylvania, to oppoſe the Turks, and likewiſe to ſupport the election of Uladiſlaus to the crown of Hungary. This detachment ſurpriſed the Turkiſh army near the river Morava, and defeated Amurath with the loſs of 30,000 men; after which Hunniades retook all the places which had been conquered by Amurath, the proud ſultan was forced to ſue for peace, and Uladiſlaus was raiſed without oppoſition to the crown of Hungary. A treaty was concluded, by which the Turks promiſed to relinquiſh their deſigns upon Hungary, to acknowledge the king's right to that crown, and to give up all their conqueſts in Raſcia and Servia. This treaty was ſealed by mutual oaths: but Uladiſlaus broke it at the perſuaſion of the pope's legate; who inſiſted, that now was the time for humbling the power of the infidels; and produced a ſpecial commiſſion from the pope, abſolving him from the oath he had taken at the late treaty. The conſequence of this perfidy was, that Uladiſlaus was entirely defeated and killed at Varna, and the greateſt part of his army cut in pieces.

68 Uladiſlaus defeated and killed by the Turks.

69 Teutonic knights ſubdued.

Uladiſlaus VI. was ſucceeded by Caſimir IV. in whoſe reign the Teutonic knights were ſubdued, and obliged to yield up the territories of Culm, Michlow, and the whole duchy of Pomerania, together with the towns of Elbing, Marienburgh, Talkmith, Schut, and Chriſtburgh, to the crown of Poland. On the other hand, the king reſtored to them all the other conqueſts he had made in Pruſſia, granted a ſeat in the Poliſh ſenate to the grand-maſter, and endowed him with other privileges, on condition that, ſix months after his acceſſion, he ſhould do homage for Pruſſia, and take an oath of fidelity to the king and republic.

This ſucceſs raiſed the ſpirits of the Poliſh nation, which had drooped ever ſince the battle of Varna. The diet did not, however, think proper to renew the war againſt the Turks, but took under their protection the hoſpodar of Moldavia; as thinking that this province would make a convenient barrier to the Poliſh dominions on one ſide. The requeſt of the prince who aſked this protection was therefore readily granted, an oath of fidelity exacted from him and the inhabitants, and a tribute required; regular payment of which was made for a great number of years afterwards.

70 Crowns of Bohemia and Hungary united to Poland.

About this time alſo the crown of Bohemia becoming vacant, the people were extremely deſirous of being governed by one of the princes of Poland; upon which the barons were induced to beſtow the crown upon Uladiſlaus, eldeſt ſon of Caſimir, in oppoſition to the intrigues of the king of Hungary. Not ſatiſfied with this acquiſition, Uladiſlaus took advantage of the diſſenſions in Hungary in order to unite that crown to his own: and this he alſo effected; by which means his power was greatly augmented, though not the felicity of his people. So many foreign expeditions had exhauſted the treaſury, and oppreſſed the peaſants with taxes; the gentry were greatly diminiſhed by a number of bloody engagements; agriculture was neglected, and the country almoſt depopulated. Before a proper remedy could be applied for theſe evils, Caſimir died in 1492; much more admired, than beloved or regretted, by his ſubjects. It is related by the hiſtorians of this period, that in the reign of Caſimir IV. the deputies of the provinces firſt appeared at the diet, and aſſumed to themſelves the legiſlative power; all laws before this time having been framed by the king in conjunction with the ſenate. It is obſerved alſo, that before Caſimir's time, the Latin language was underſtood only by the clergy of Poland; in proof of which, it is alleged, that at an interview between this prince and the king of Sweden at Dantzick, his Poliſh majeſty was forced to make uſe of the aſſiſtance of a monk to interpret between him and the Swediſh monarch. Caſimir, aſhamed of the ignorance ſhown by himſelf and court, publiſhed an edict, enjoining the diligent ſtudy of the Latin, which in our days is ſpoken as vernacular by every Poliſh gentleman, though very unclaſſically.

During the ſucceeding reigns of John, Albert, and Alexander, the Poliſh affairs fell into decline; the kingdom being haraſſed by continual wars with the Turks and Tartars. However, they were retrieved by Sigiſmund I. who aſcended the throne in 1507. This monarch, having reformed ſome internal abuſes, next ſet about rendering the kingdom as formidable as it had formerly been. He firſt quelled a rebellion which broke out in Lithuania; after which, he drove the Walachians and Moldavians out of Ruſſia Nigra, and defeated the Ruſſians in a pitched battle, with the loſs of 30,000 men. In this engagement he was obliged to cauſe his cavalry to ſwim acroſs the Boriſthenes in order to begin the attack, while a bridge was preparing for the infantry. Theſe orders were executed with aſtoniſhing celerity, notwithſtanding the rapidity of the ſtream, the ſteepneſs of the banks, and the enemy's oppoſition. The onſet was led by the Lithuanians, who were directed to retreat gradually, with a view of drawing the enemy within reach of the cannon. This the Ruſſians miſtook for a real flight; and as they were purſuing with eagerneſs, Sigiſmund opened his line to the right and left, pouring in grape-ſhot from the artillery with dreadful ſucceſs. The Ruſſian general, and ſeveral noblemen of the firſt diſtinction, were taken priſoners, while the whole loſs of the royal army did not amount to 300 men.

71 Exploits of Sigiſmund I.

After this complete victory, the king turned his arms againſt the Teutonic knights, who had elected the marquis of Brandenburgh their grand-maſter; and this prince not only refuſed to acknowledge the ſovereignty of the crown of Poland, but even invaded the Poliſh territories. Sigiſmund marched againſt him, and gained poſſeſſion of ſeveral important places in Brandenburgh; but as he was purſuing his conqueſts, the marquis was reinforced by 14,000 Germans, led by the duke of Schonenburg, who ventured to lay ſiege to Dantzic, after having ravaged all the neighbouring country. The Dantzickers, however, defended themſelves with ſo much ſpirit, that the beſiegers were ſoon obliged to relinquiſh their enterpriſe. In their retreat they were attacked by a ſtrong detachment of Poliſh cavalry, who made prodigious havock among them, and compelled the wretched remains to take ſhelter in Pomerania, where they were inhumanly butchered by the peaſants. Soon after this the marquis was obliged to ſubmit to the clemency of the conqueror; from whom, however, he obtained better conditions than could have been expected, or indeed than he would have got, had he not abandoned the intereſt of the Teutonic order, and reſigned the dignity of grand-maſter. In order to ſecure him in his intereſt, therefore, Sigiſmund granted him half the province of Pruſſia as a ſecular duke, and dependent on the crown of Poland; by which means he entirely deprived that order of the beſt part of their dominions, and put it quite out of their power to diſturb the tranquillity of Poland any more.

The power of Sigiſmund had now excited the jealouſy of the houſe of Auſtria; for which reaſon they took every method in their power to ſtir up enemies againſt him. By their means, the Ruſſians, Moldavians, and Tartars, were all excited to fall upon the Poliſh territories at once. The vaivode of Walachia, with 50,000 men, made an irruption into the ſmall province of Pokatior, but was entirely defeated by count Taro at the head of no more than 6000. This victory is wholly aſcribed to the good conduct of the commander, who poſſeſſed himſelf of ſome eminences on the flanks of the enemy. On theſe he erected batteries; which played with ſuch fury as ſoon put their ranks in diſorder: upon which the Poles attacked them ſword in hand, and entirely diſperſed them with the loſs of 10,000 killed or taken. The count having then augmented his army with a ſtrong body of Lithuanians, attacked the Muſcovites and Tartars, drove them entirely out of the duchy, purſued them into Ruſſia, reduced ſeveral towns, and at laſt laid ſiege to the ſtrong fortreſs of Straradub; in which the regent, together with ſome of the beſt troops of Ruſſia, were incloſed. The garriſon made a gallant defence; and the fortifications were compoſed of beams joined together, and ſupported by a bulwark of earth, upon which the cannon-ſhot made no impreſſion: but the count contrived a method of ſetting the wood on fire; by which means the regent and nobility were obliged to ſurrender at diſcretion, and Taro carried off upwards of 60,000 priſoners, with an immenſe booty.

In the reign of Sigiſmund, we may look upon the kingdom of Poland to have been at its greateſt pitch of glory. This monarch poſſeſſed, in his own perſon, the republic of Poland, the great duchies of Lithuania, Smolenſko, and Saveria, beſides vaſt territories lying beyond the Euxine and Baltic; while his nephew Lewis poſſeſſed the kingdoms of Bohemia, Hungary, and Sileſia. But this glory received a ſudden check in 1548, by the defeat and death of Louis, who periſhed in a battle fought with Solyman the Great, emperor of the Turks. The daughter of this prince married Ferdinand of Auſtria; whereby the dominions of Hungary, Bohemia, and Sileſia, became inſeparably connected with the hereditary dominions of the Auſtrian family. This misfortune is thought to have haſtened the death of Sigiſmund; though, being then in his 84th year, he could not have lived long by the ordinary courſe of nature. He did not, however, ſurvive the news many months, but died of a lingering diſorder, leaving behind him the character of the completeſt general, the ableſt politician, the beſt prince, and the ſtrongeſt man, in the north; of which laſt, indeed, ſome inſtances are related by hiſtorians that are almoſt incredible.

72
Sigiſmund Auguſtus, a wiſe and valiant prince.

Sigiſmund Auguſtus, who ſucceeded his father Sigiſmund I. proved alſo a very great and happy prince. At that time the moſt violent and bloody wars were carrying on in Germany, and indeed through other parts of Europe, on account of religion; but Sigiſmund wiſely avoided interfering in theſe diſputes. He would not admit into his dominions any of thoſe divines who were taxed with holding heterodox opinions, nor even allow his people the liberty of correſponding with them; yet he never perſecuted, or employed any other means for the preſervation of the ſtate than thoſe of a well-conducted and regular policy. Inſtead of diſputing with his ſubjects about ſpeculative opinions, Sigiſmund applied himſelf diligently to the reforming of abuſes, enforcing the laws, enriching the treaſury, promoting induſtry, and redeeming the crown-lands where the titles of the poſſeſſors appeared illegal. Out of the revenue recovered in this manner he obtained a formidable ſtanding army, without laying any additional tax upon the ſubjects; and though he preferred peace to war, he was always able to puniſh thoſe that offered indignities to his crown or perſon. His knowledge in the art of war was ſoon tried in a conteſt with the Ruſſians, who had made an irruption into Livonia, encouraged by the diſputes which had ſubſiſted between the Teutonic knights and the archbiſhop of Riga, couſin to Sigiſmund. The province was at that time divided between the knights and the prelate; and the Ruſſians under pretence of aſſiſting the former, had ſeized great part of the dominions of the latter. The archbiſhop had recourſe to his kinſman the king of Poland; who, after fruitleſs efforts to accommodate matters, marched towards the frontiers of Livonia with an army of 100,000 men. The knights were by no means able to reſiſt ſuch a formidable power; and therefore, deſerting their late allies, put themſelves under the protection of the king of Poland. The czar, John Baſilides, though deſerted by the knights, did not loſe his courage; nay, he even inſolently refuſed to return any anſwer to the propoſals of peace made by Sigiſmund. His army conſiſted of 300,000 men, with whom he imagined himſelf able to reduce all Livonia, in ſpite of the utmoſt efforts of the king of Poland: however, having met with ſome checks on that quarter, he directly invaded Poland with his whole army. At firſt he carried every thing before him; but the Poles ſoon made a vigorous oppoſition. Yet the Ruſſians, though everywhere defeated, ſtill continued their incurſions, which Sigiſmund at laſt revenged by invading Ruſſia in his turn. Theſe mutual deſolations and ravages at laſt made both parties deſirous of peace, and a truce for three years was agreed on; during the continuance of which the king of Poland died, and with him was extinguiſhed the houſe of Jagellon, which had governed Poland for near 200 years.

73
War with Ruſſia.

74
Extinction of the houſe of Jagellon.

On the death of Sigiſmund, Poland became a prey to inteſtine diviſions; and a vaſt number of intrigues were ſet on foot at the courts of Vienna, France, Saxony, Sweden, and Bradenburgh; each endeavouring to eſtabliſh a prince of their own nation on the throne of Poland. The conſequence of all this was, that the kingdom became one univerſal ſcene of corruption, faction, and confuſion; the members of the diet conſulted only their own intereſt, and were ready on every occaſion to ſell themſelves to the beſt bidder. The Proteſtants had by this time got a conſiderable footing in the kingdom, and thus religious diſputes were intermingled

75
Diſtracted ſtate of Poland.

termingled with political ones. One good effect, however, flowed from this confuſion: for a law was paſſed, by which it was enacted, that no difference in religious opinions ſhould make any contention among the ſubjects of the kingdom; and that all the Poles, without diſcrimination, ſhould be capable of holding public offices and truſts under the government; and it was alſo reſolved, that the future kings ſhould ſwear expreſsly to cultivate the internal tranquillity of the realm, and cheriſh without diſtinction their ſubjects of all perſuaſions.

76
Duke of Anjou choſen king of Poland.

While the candidates for the throne were ſeverally attempting to ſupport their own intereſt in the beſt manner they could, John Craſoſki, a Poliſh gentleman of great merit, but diminutive ſtature, had juſt returned from France, whither he had travelled for improvement. His humour, wit, and diverting ſize, had rendered him univerſally agreeable at the court of France, and in a particular manner engaged the eſteem of Catharine de Medicis, which the little Pole had the addreſs to make uſe of for his own advantage. He owed many obligations to the duke of Anjou; whom, out of gratitude, he repreſented in ſuch favourable terms, that the Poles began to entertain thoughts of making him their king. Theſe ſentiments were confirmed and encouraged by Craſoſki, who returned into France by order of ſeveral leading men in Poland, and acquainted the king and queen Catharine, that nothing was wanting beſides the formality of an embaſſy to procure the crown for the duke of Anjou, almoſt without oppoſition. Charles IX. king of France, at that time alſo promoted the ſcheme, being jealous of the duke of Anjou's popularity, and willing to have him removed to as great a diſtance as poſſible. Accordingly the parties came to an agreement; and it was ſtipulated that the duke of Anjou ſhould maintain the laws, liberties, and cuſtoms of the kingdom of Poland, and of the grand duchy of Lithuania; that he ſhould tranſport all his effects and annual revenues in France into Poland; that the French monarch ſhould pay the late king Sigiſmund's debts; that he ſhould maintain 100 young Poliſh gentlemen at his court; and 50 in other places; that he ſhould ſend a fleet to the Baltic, to aſſiſt Poland againſt the Ruſſians; and laſtly, that Henry ſhould marry the Princeſs Anne, ſiſter to the late king Sigiſmund; but this article Henry would not ratify till his return to Poland.

77
Runs away from his kingdom,

Every thing being thus ſettled, the young king quitted France, attended by a ſplendid retinue, and was accompanied by the queen-mother as far as Lorrain. He was received by his ſubjects on the frontiers of Poland, and conducted to Cracow, where he was ſoon after crowned. The affections of the Poles were ſoon engaged by the youth and accompliſhments of Henry; but ſcarce was he ſeated on the throne, when, by the death of Charles IX. he became heir to the crown of France. Of this he was informed by repeated meſſages from queen Catharine; he repented his having accepted the crown of Poland, and reſolved to leave it for that of France. But being ſenſible that the Poles would oppoſe his departure, he kept his intentions ſecret, and watched an opportunity of ſtealing out of the palace in diſguiſe in the night time. The Poles, as might well have been expected, were irritated at being thus abandoned, from the mere motive of intereſt, by a prince whom they had loved and honoured ſo much. Parties were diſpatched after him by different roads; and Zamoſki, a nobleman who headed one of theſe parties, overtook him ſome leagues diſtant from Cracow. All the prayers and tears of that nobleman, however, could not prevail on Henry to return; he rode poſt to Vienna, and then paſſed into France by the way of Italy.

78
And is depoſed.

In the mean time, the Poles were ſo much exaſperated againſt Henry and his whole nation, that all the French in Cracow would have been maſſacred if the magiſtrates had not placed guards in the ſtreets. Henry, however, had foreſeen the conſequences of this flight, and therefore endeavoured to apologiſe for his behaviour. One Danzai undertook his cauſe in full ſenate; and with great eloquence explained the king's motives for his abrupt departure. Henry alſo wrote to the chief nobility and clergy with his own hand. But nothing could ſatisfy the Poles; who now acquainted their king, that if he did not immediately return, they would be obliged to diveſt him of the royal dignity, and to chooſe another ſovereign. Henry began to excuſe himſelf on account of the wars in which he was engaged, and promiſed to ſend men of unexceptionable integrity to govern Poland till he ſhould return: but no excuſes could be accepted; and, on the 15th of July 1575, he was ſolemly diveſted of the regal dignity in full diet, and the throne declared vacant.

79
Stephen Batori choſen king,

After the depoſition of Henry, commotions and factions again took place. However, the contending parties were now reduced to two; one who ſupported the intereſt of Maximilian emperor of Germany; the other, who were for electing the princeſs Anne, and marrying her to Stephen Batori prince of Tranſylvania. The latter prevailed through the courage of one gentleman, who, in imitation of the power aſſumed by the Roman tribunes, ſtood up in the full ſenate, and oppoſed the proclamation of Maximilian, declaring that his election was violent and illegal. In this ſituation of affairs, it was obvious that ſtrength and celerity muſt determine which election was legitimate: both parties wrote to the princes whoſe cauſe they had eſpouſed, intreating them to come with all poſſible expedition to take poſſeſſion of the throne. Batori proved the more alert; for while Maximilian was diſputing about certain conditions which the Poles required for the ſecurity of their privileges, he entered Poland, married the princeſs, and was crowned on the firſt of May 1576.

80
Dantzic revolts.

No oppoſition was made to the authority of Batori except by the inhabitants of Dantzic. Theſe adhered to the intereſt of Maximilian even after he was dead, and had the preſumption to demand from the king an oath acknowledging their abſolute freedom and independence. Batori referred them to the ſenate, declaring that he had no right to give up the privileges of the republic; but admoniſhed the citizens to avoid all occaſion of a civil war, which muſt neceſſarily terminate in their diſadvantage. But the obſtinate citizens, conſtruing the king's lenity into fear, ſhut the gates againſt the ambaſſador, ſeized upon the fortreſs of Grebin, and publiſhed a manifeſto reſembling a libel upon the king and the republic. The king, incenſed at theſe proceedings, marched againſt Grebin, retook the caſtle, and ravaged certain territories belonging to the Dantzickers; who retaliated by burning to the ground a monaſtery named *Oliva*, to prevent the Poles from taking poſſeſſion of ſo important a ſituation.

Notwithſtanding theſe outrages, Batori renewed his overtures for an accommodation: but the Dantzickers were deaf to theſe ſalutary propoſals; ſo that he was obliged to declare them rebels, and ſend againſt them a body of troops under one Zborowſki. As the number of the Poliſh army, however, was not conſiderable, the Dantzickers marched out to give him battle. They were aſſiſted by a corps of Germans, and a reſolution was formed of attacking the Poles in their camp by ſurpriſe; but the project was diſconcerted by a ſudden ſtorm, accompanied with dreadful thunder and lightning, which ſpread a panic through the army, as if it had been a judgment from heaven, and obliged the commander, John de Collen, to retire into the city. In a ſhort time, however, they recovered their ſpirits, and came to an action with the Poles; but were defeated with the loſs of 8000 men killed on the ſpot, a great many taken priſoners, and the loſs of ſeveral pieces of cannon. But this check, inſtead of abating the courage of the Dantzickers, only animated them the more, and they reſolved to hold out to the laſt extremity. In the mean time, the czar of Muſcovy, thinking the preſent opportunity favourable for extending his dominions, laid ſiege to Revel; but, not being able to make himſelf maſter of that place, he was obliged to content himſelf with ravaging Livonia, which he did in a dreadful manner. This did not, however, hinder Batori from laying ſiege to Dantzic in perſon, and purſuing the operations with the utmoſt vigour. Collen made many vigorous ſallies, in ſeveral of which he defeated the Poles; but happening at laſt to be killed, nobody was found capable of ſupplying his place, and the citizens were at laſt obliged to ſurrender at diſcretion; though not till they had obtained a promiſe from the elector of Saxony and landgrave of Heſſe of interpoſing as mediators in their behalf. The only terms which the king demanded of them were, that they ſhould aſk his pardon, diſmiſs their troops, and rebuild the monaſtery of Oliva which they had deſtroyed; while his majeſty, on the other hand, confirmed all their privileges, and granted them full liberty of adhering to the confeſſion of Augſburg, for which they had for ſome time been ſtrenuous advocates.

81 Poland invaded by the Ruſſians.

82 Dantzic ſubmits.

83 Cruelty of the Ruſſians.

The war with Dantzic was no ſooner ended, than the king directed his whole ſtrength againſt the czar of Muſcovy, who had made himſelf maſter of ſeveral important cities in Livonia. The czar behaved every where with the greateſt cruelty, ſlaughtering all without diſtinction who were able to bear arms, and abandoning the women and children to the ſhocking brutality of the Tartars who ſerved in his army. Such was the horror inſpired by the perfidy and cruelty of the czar's conduct, that the inhabitants of Wender choſe rather to bury themſelves in the ruins of their town than to ſubmit to ſuch an inhuman enemy. For a conſiderable time the Ruſſians were allowed to proceed in this manner, till the whole province of Livonia, excepting Riga and Revel, had ſuffered the barbarities of this inſulting conqueror; but at laſt, in 1578, a body of forces was diſpatched into the province, the towns of Wender and Dunnenburg were ſurpriſed, and an army ſent by the czar to ſurpriſe the former was defeated.

At this time the Muſcovites were not the only enemies who oppoſed the king of Poland, and oppreſſed Livonia. That unhappy province was alſo invaded by the Swedes, who profeſſed themſelves to be enemies equally to both parties, and who were ſcarce inferior in cruelty to the Ruſſians themſelves. The king, however, was not daunted by the number of his adverſaries; but having made great preparations, and called to his aſſiſtance Chriſtopher prince of Tranſylvania, with all the ſtanding forces of that country, he took the field in perſon againſt the Muſcovites, and laid ſiege to Polocz, a town of great importance ſituated on the river Dwina. The Ruſſians no ſooner heard of the approach of the Poliſh army, than they reſolved to put all the citizens to death, thinking by this means to ſtrike terror into the enemy. When Batori came near the town, the moſt ſhocking ſpectacle preſented itſelf; the river appeared dyed with blood, and a vaſt number of human bodies faſtened to planks, and terribly mangled, were carried down its ſtream. This barbarity, inſtead of intimidating the Poles, irritated them to ſuch a degree, that nothing could reſiſt them. Finding that their cannon made little impreſſion upon the walls of the city, which were conſtructed of wood, they advanced to the aſſault with burning torches in their hands; and would ſoon have reduced the fortifications to aſhes, had not a violent ſtorm of rain prevented them. The deſign, however, was put in execution as ſoon as the rain ſlackened; and the barbarous Ruſſians were obliged to ſurrender at diſcretion. It reflects the higheſt honour on Batori, that, notwithſtanding the dreadful inſtances of cruelty which he had before his eyes, he would not ſuffer his ſoldiers to retaliate. Indeed the cruelties committed by the Ruſſians on this occaſion, ſeem almoſt to have authoriſed any revenge that could poſſibly have been taken. A number of Germans were found in the city, ſome expiring under the moſt dreadful tortures, and others dead of pains which nature could no longer ſupport. Several of the officers had been dipped in cauldrons of boiling oil, with a cord drawn under the ſkin of the umbilical region, which faſtened their hands behind; in which ſituation their eyes had been torn out from their ſockets, or burnt with red-hot irons, and their faces otherwiſe terribly mangled. The diſfigured carcaſes, indeed, plainly ſhowed the barbarous treatment they had met with; and the dreadful tale was confirmed by the teſtimony of the few who ſurvived. The Poliſh ſoldiers were exaſperated almoſt to madneſs; ſo that ſcarce all the authority of Batori could reſtrain them from cutting in pieces the wretches who had been the authors of ſuch a dreadful tragedy.

84 Siege of Polocz.

85 Monſtrous barbarities committed by the Ruſſians in that city.

86 Ruſſia ravaged by Batori.

After the reduction of Polocz, Batori continued the war with great ſucceſs. Two detachments from the army penetrated the enemy's country by different roads, waſted all before them to the gates of Smolenſko, and returned with the ſpoils of 2000 villages which they had pillaged and deſtroyed. In the mean time the Swedes and Poles thought proper to come to an accommodation: and though John king of Sweden was at that time prevented from bearing his ſhare of the war, yet Batori reduced ſuch a number of cities, and committed

87 The Czar ſues for peace.

ſuch devaſtation in the Ruſſian territories, that the czar was obliged to ſue for peace; which he obtained on condition of relinquiſhing Livonia, after having thrown away the lives of more than 400,000 of his ſubjects in attempting to conquer it.

88 Batori civilizes the Coſſacks.

Batori, being thus freed from a moſt deſtructive and cruel war, applied himſelf to the internal government of his kingdom. He regulated the Poliſh cavalry in ſuch a manner as made them become formidable to the Turks and other neighbouring nations: and this is the military eſtabliſhment to which the Poles have given the name of *quartienne;* becauſe a fourth part of the revenue is employed in ſupporting them. Batori ſent this body of cavalry towards the frontiers of Tartary, to check the incurſions of thoſe barbarians; by which means the Ukraine, a vaſt tract of deſert country, was filled with flouriſhing towns and villages, and became a ſtrong barrier againſt the Turks, Tartars, and Ruſſians. The laſt memorable action of Batori was his attaching the Coſſacks to Poland, civilizing and inſtructing them in the arts of war and peace. His firſt endeavour was to gain their affections by his liberality; for which purpoſe, he preſented them with the city of Techtemeravia, ſituated on the Boriſthenes, which they formed into a magazine, and made the reſidence of their chieftains. He gave them officers of all degrees, eſtabliſhed diſcipline among them, altered their arms, and formed them into a regular militia, which afterwards performed eminent ſervices to the ſtate. All kinds of manufactures at that time known in Poland were likewiſe eſtabliſhed among the Coſſacks; the women were employed in ſpinning and weaving woollen cloths, while the men were taught agriculture, and other arts proper for their ſex.

While Batori was employed in this manner, the Swedes broke the convention into which they had entered with Poland, and were on the point of getting poſſeſſion of Riga. To this, indeed, Batori himſelf had given occaſion, by attempting to impoſe the Romiſh religion upon the inhabitants, after having promiſed them entire liberty of conſcience. This ſo irritated them, that they revolted, and were on the point of admitting a Swediſh garriſon into the city, when the king was informed of what was going forward. Upon this he reſolved to take a moſt exemplary vengeance on the inhabitants of Riga; but before he could execute his intention, he died in the year 1586, the 54th of his age, and 10th of his reign.

89 His death.

The death of Batori involved Poland in freſh troubles. Four candidates appeared for the crown, viz. the princes Erneſt and Maximilian of the houſe of Auſtria; Sigiſmund prince of Sweden, and Theodore czar of Muſcovy. Each of theſe had a ſeparate party; but Sigiſmund and Maximilian managed matters ſo well, that in 1587 both of them were elected. The conſequence of this was a civil war; in which Maximilian was defeated and taken priſoner: and thus Sigiſmund III. ſurnamed *De Vaſa*, became maſter of the throne of Poland without oppoſition. He waged a ſucceſsful war with the Tartars, and was otherwiſe proſperous; but though he ſucceeded to the crown of Sweden, he found it impoſſible for him to retain both kingdoms, and he was formally depoſed from the Swediſh throne. In 1610 he conquered Ruſſia, and placed his ſon on the throne; but the Poliſh conqueſts of that country have always been but for a ſhort time. Accordingly the young prince was ſoon after depoſed; and the Ruſſians not only regained their liberty, but began to make encroachments on Poland itſelf. A very unfortunate war alſo took place with Sweden, which was now governed by the great Guſtavus Adolphus; the particulars of which, with the other exploits of that renowned warrior, are related under the artical **Sweden**. At laſt Sigiſmund, worn out with cares and misfortunes, died in 1629.

90 War with Guſtavus Adolphus.

After Sigiſmund's death the affairs of Poland ſeemed to revive a little under Uladiſlaus VII.; for he obliged the Ruſſians to ſue for peace, and Sweden to reſtore ſome of her conqueſts: but having attempted to abridge the liberty of the Coſſacks, they revolted, and gave the Poles ſeveral terrible defeats. Nor was the war terminated in the lifetime of Uladiſlaus, who died in 1648. His ſucceſſor, John Caſimir, concluded a peace with theſe dangerous enemies: but the war was ſoon after renewed; and while the kingdom was diſtracted between theſe enemies and the diſcontents of its own inhabitants, the Ruſſians took the opportunity of invading and pillaging Lithuania. In a little after the whole kingdom was ſubdued by Charles Guſtavus, ſucceſſor to Chriſtina queen of Sweden.

91 Poland ſubdued by Charles Guſtavus.

Happily for Poland, however, a rupture took place between the courts of Sweden and Copenhagen; by which means the Poles were enabled to drive out the Swedes in 1657. This was ſucceeded by civil wars and conteſts with Ruſſia, which ſo much vexed the king, that he reſigned the crown in 1668.

For two years after the reſignation of Caſimir the kingdom was filled with confuſion; but on the 17th of September 1670, one Michael Coributt Wieſnowiſki, collaterally deſcended from the houſe of Jagello, but in a very mean ſituation at that time, was choſen king. His reign continued but for three years; during which time John Sobieſki, a celebrated Poliſh general, gave the Turks a dreadful overthrow, though their army conſiſted of more than 300,000 men; and had this blow been purſued, the Coſſacks would have been entirely ſubdued, and very advantageous terms might have been obtained from the ſultan. Of that vaſt multitude of Turks no more than 15,000 made their eſcape, the reſt being all either killed or taken: however, the Poliſh ſoldiers, being bound by the laws of their country only to ſtay a certain time in the field, they refuſed to purſue this ſignal victory, and ſuffered the king to make peace on any terms he could procure.

92 John Sobieſki retrieves the Poliſh affairs.

Wieſnowiſki died before the news of this tranſaction reached Cracow; and after his death a new ſcene of confuſion enſued, till at laſt the fortune of John Sobieſki prevailed, and he was elected king of Poland in 1674. He was a moſt magnanimous and heroic prince; who, by his valour and good conduct, retrieved the affairs of Poland, and entirely checked the progreſs of the Turks weſtward. Theſe barbarians were everywhere defeated, as is particularly related under the article **Turky**; but notwithſtanding his great qualities, Poland was now ſo thoroughly corrupted, and pervaded by a ſpirit of diſaffection, that the latter part of this monarch's reign was involved in troubles, through the ambition and contention of ſome powerful noblemen.

Sobieſki died in 1696; and with him fell the glory of Poland. Moſt violent conteſts took place about the ſucceſſion; the recital of which would far exceed our limits.

93 Poland conquered by Charles XII.

limits. At laſt Frederic Auguſtus, elector of Saxony, prevailed; but yet, as ſome of the moſt eſſential ceremonies were wanting in his coronation, becauſe the primate, who was in an oppoſite intereſt, would not perform them, he found it extremely difficult to keep his ſubjects in proper obedience. To add to his misfortunes, having engaged in a league with Denmark and Ruſſia againſt Sweden, he was attacked with irreſiſtible fury by Charles XII. Though Auguſtus had not been betrayed, as indeed he almoſt always was, he was by no means a match for the ferocious Swede. The particulars of this war, however, as they make great part of the exploits of that northern hero, more properly fall to be related under the article SWEDEN. Here, therefore, we ſhall only obſerve, that Auguſtus was reduced to the humiliating neceſſity of renouncing the crown of Poland on oath, and even of congratulating his rival Staniſlaus upon his acceſſion to the throne: but when the power of Charles was broken by his defeat at Pultowa, the fortune of Auguſtus again prevailed; Staniſlaus was driven out; and the former being abſolved from his oath by the pope, reſumed the throne of Poland.

94 Degeneracy of the Poles.

95 Elevation of Poniatowſki, by the name of Staniſlaus Auguſtus, to the throne.

Since that time the Poliſh nation hath never made any figure. Surrounded by great and ambitious powers, it hath ſunk under the degeneracy of its inhabitants; ſo that it now ſcarce exiſts as a nation. This cataſtrophe took place in the following manner: On the 5th of October 1763, died Auguſtus III. elector of Saxony, and king of Poland. He was ſucceeded by Count Poniatowſki, a poliſh grandee, who was proclaimed September 7th 1764, by the name of *Staniſlaus Auguſtus*, and crowned on the 25th of November the ſame year.—During the interregnum which took place between the death of Auguſtus III. and the election of Staniſlaus, a decree had been made by the convocation-diet of Poland, with regard to the *diſſidents*, as they were called, or deſſenters from the Popiſh religion. By this decree they were prohibited from the free exerciſe of their religion, much more than they had formerly been, and totally excluded from all poſts and places under the government. On this ſeveral of the European powers interpoſed, at the application of the diſſidents, for their good offices. The courts of Ruſſia, Pruſſia, Great Britain, and Denmark, made remonſtrances, to the diet; but, notwithſtanding, theſe remonſtrances, the decree was confirmed by the coronation-diet held after the king's election.

96 Interference of foreign powers in behalf of the diſſidents.

October 6. 1766, an ordinary diet was aſſembled. Here declarations from the courts abovementioned were preſented to his Poliſh majeſty, requiring the re-eſtabliſhment of the diſſidents in their civil rights and privileges, and the peaceable enjoyment of their modes of worſhip ſecured to them by the laws of the kingdom which had been obſerved for two centuries. Theſe privileges, it was alleged, had been confirmed by the treaty of Oliva, concluded by all the northern powers, which could not be altered but by the conſent of all the contracting parties. The Popiſh party contended ſtrongly for a confirmation of ſome decrees made againſt the diſſidents in 1717, 1723, and 1736. The deputies from the foreign powers replied, that thoſe decrees had paſſed in the midſt of inteſtine troubles, and were contradicted by the formal proteſtations and expreſs declarations of foreign powers. At laſt, after violent conteſts, the matter was referred to the biſhops and ſenators for their opinion. Upon a report for them, the diet came to a reſolution, That they would fully maintain the diſſidents in all the rights and prerogatives to which they were intitled by the laws of their country, particularly by the conſtitutions of the year 1717, &c. and by treaties; and that as to their complaints with regard to the exerciſe of their religion, the college of archbiſhops and biſhops, under the direction of the prince primate, would endeavour to remove thoſe difficulties in a manner conformable to juſtice and neighbourly love.—By this time, however, the court of Ruſſia ſeemed determined to make her remonſtrances more effectual, and a ſmall body of Ruſſian troops marched to within two miles of the capital of Poland.

Theſe reſolutions of the diet were by no means agreeable to the diſſidents. They dated the beginning of their ſufferings from the year 1717. The referring their grievances to the archbiſhops and biſhops was looked upon as a meaſure the moſt unreaſonable that could be imagined, as that body of men had always been their oppoſers, and in fact the authors of all the evils which had befallen them.—Shortly after matters were conſidered in this view, an additional body of Ruſſians, to the number of about 15,000, entered Poland.

97 Conſequences of this.

The diſſidents, being now pretty ſure of the protection of foreign powers, entered, on the 20th of March 1767, into two confederacies, at Thorn and Sluck. One of them was ſigned by the diſſidents of Great and Little Poland, and the other by thoſe of the Great Duchy of Lithuania. The purport of theſe confederacies was, an engagement to exert themſelves in the defence of their ancient privileges, and the free exerciſe of their religion; profeſſing, at the ſame time, however, the utmoſt loyalty to the king, and reſolving to ſend a deputation to him to implore his protection. They even invited thoſe of the Catholic communion, and all true patriots, to unite with them in maintaining the fundamental laws of the kingdom, the peace of religion, and the right of each one jointly with themſelves. They claimed, by virtue of public treaties, the protection of the powers who were gurantees of their rights and liberties; namely, the empreſs of Ruſſia, and the kings of Sweden, Great Britain, Denmark, and Pruſſia. Laſtly, they proteſted, that they had no intention of acting to the detriment of the Roman Catholic religion, which they duly reſpected; and only aſked the liberty of their own, and the re-eſtabliſhment of their ancient rights. The three cities of Thorn, Elbing, and Dantzic, acceded to the confederacy of Thorn on the 10th of April; as did the duke and nobles of Courland to that of Sluck on the 15th of May.

The empreſs of Ruſſia and king of Pruſſia, in the mean time, continued to iſſue forth new declarations in favour of the diſſidents; and the Ruſſian troops in Poland were gradually augmented to 30,000 men. Great numbers of other confederacies were alſo formed in different parts of the kingdom. Theſe at firſt took little part in the affairs of the diſſidents; they complained only of the adminiſtration of public affairs, into which they alleged that innovations had been introduced, and were therefore for ſome time called *confederations of malcontents*. All theſe confederacies publiſhed manifeſtoes.

in which they recommended to the inhabitants to quarter and treat the Ruſſian troops as the defenders of the Poliſh liberties.

98
General confederacy.

The different confederacies of malcontents formed in the 24 diſtricts of Lithuania united at Wilna on the 22d of June; and that general confederacy re-eſtabliſhed prince Radzivil, who had married the king's ſiſter, in his liberty, eſtates, and honour, of which he had been deprived in 1764 by the ſtates of that duchy. On the 23d of June prince Radzivil was choſen grand marſhal of the general confederacy of all Poland, which then began to be called the *national confederacy*, and was ſaid to be compoſed of 72,000 noblemen and gentlemen.

The general confederacy took ſuch meaſures as appeared moſt proper for ſtrengthening their party. They ſent to the ſeveral waywodes of the kingdom, requiring their compliance with the following articles: 1. That all the gentlemen who had not ſigned the confederacy ſhould do it immediately; 2. That all the courts of juſtice ſhould ſubſiſt as formerly, but not judge any of the confederates; 3. That the marſhals of the crown ſhould not paſs any ſentence without the participation of at leaſt four of the confederates; and, 4. That the marſhals of the crown and the treaſurers ſhould be immediately reſtored to the poſſeſſion of their reſpective rights. The Catholic party in the mean time were not idle. The biſhop of Cracow ſent a very pathetic and zealous letter to the dietines aſſembled at Warſaw on the 15th of Auguſt, in which he exhorted them to arm their nuncios with courage, by giving them orthodox and patriotic inſtructions, that they might not grant the diſſidents new advantages beyond thoſe which were ſecured to them by the conſtitutions of the country, and treaties with foreign powers, &c. The pope alſo ſent briefs to the king, the great chancellor, the nobleſſe, biſhops of the kingdom, and to the prince primate, with ſuch arguments and exhortations as were thought moſt proper to ward off the impending danger. Councils in the mean time were frequently held at the biſhop of Cracow's palace, where all the prelates at Warſaw aſſembled.

On the 26th of September 1767 the confederacy of diſſidents was united with the general confederacy of malcontents in the palace of prince Radzivil, who on that occaſion expreſſed great friendſhip for the diſſidents. In a few days after, the Ruſſian troops in the capital were reinforced, and a conſiderable body of them was poſted at about five miles diſtance.

99
Tumults in the diet.

On the 5th of October an extraordinary diet was held: but the affair of the diſſidents met with ſuch oppoſition, that it was thought neceſſary to adjourn the meeting till the 12th; during which interval, every expedient was uſed to gain over thoſe who oppoſed prince Radzivil's plan. This was, to appoint a commiſſion, furniſhed with a full power to enter into conference with prince Repnin, the Ruſſian ambaſſador, concerning the affairs of the diſſidents. Nothwithſtanding all the pains taken, however, the meeting of the 12th proved exceedingly tumultuous. The biſhops of Cracow and Kiow, with ſome other prelates, and ſeveral magnats, declared, that they would never conſent to the eſtabliſhment of ſuch a commiſſion; and at the ſame time ſpoke with more vehemence than ever againſt the pretenſions of the diſſidents. Some of the deputies anſwered with great warmth; which occaſioned ſuch animoſities, that the meeting was again adjourned till the 16th.

100
Violent proceedings of the Ruſſians.

On the 13th the biſhops of Cracow and Kiow, the palatine of Cracow, and the ſtaroſte of Dolmſki, were carried off by Ruſſian detachments. The crime alleged againſt them, in a declaration publiſhed next day by prince Repnin, was, that they had been wanting in reſpect to the dignity of the empreſs of Ruſſia, by attacking the purity of her intentions towards the republic; though ſhe was reſolved to continue her protection and aſſiſtance to the general confederacy united for preſerving the liberties of Poland, and correcting all the abuſes which had been introduced into the government, &c.

101
Confederacy of Bar.

It was probably owing to this violent proceeding of the Ruſſians, that prince Radzivil's plan was at laſt adopted, and ſeveral new regulations were made in favour of the diſſidents. Theſe innovations, however, ſoon produced a civil war, which at laſt ended in the ruin of the kingdom. In the beginning of the year 1768, a new confederacy was formed in Podolia, a province bordering on Turkey, which was afterwards called the *confederacy of Bar*. The intention of it was, to aboliſh, by force of arms, the new conſtitutions, particularly thoſe in favour of the diſſidents. The members of the new confederacy likewiſe expreſſed great reſentment againſt the carrying away the biſhops of Cracow, &c. and ſtill detaining them in cuſtody.

Podolia was reckoned the fitteſt place for the purpoſe of the confederates, as they imagined the Ruſſians could not attack them there without giving umbrage to the Ottoman court. Similar confederacies, however, were quickly entered into throughout the kingdom: the clergy excited all ranks of men to exert themſelves in defence of their religion; and ſo much were their exhortations regarded, that even the king's troops could not be truſted to act againſt theſe confederates. The empreſs of Ruſſia threatened the new confederates as diſturbers of the public tranquillity, and declared that her troops would act againſt them if they perſiſted. It was, however, ſome time before the Ruſſian troops were conſiderably reinforced; nor did they at firſt ſeem inclined to act with the vigour which they might have exerted. A good many ſkirmiſhes ſoon happened between theſe two contending parties, in which the confederates were generally defeated. In one of theſe the latter being worſted, and hardly preſſed, a number of them paſſed the Nieſter, and took refuge in Moldavia. This province had formerly belonged to Poland, but was now ſubject to the Grand Signior: the Ruſſians, however, purſued their enemies into Moldavia; but in order to prevent any offence being taken by the Porte, prince Repnin wrote to the Ruſſian reſident at Conſtantinople, to intimate there, that the conduct of the Ruſſian colonel who commanded the party was quite contrary to the orders of his court, and that therefore he would be turned out of his poſt.

Great cruelty in the mean time was exerciſed againſt the diſſidents where there were no Ruſſian troops to protect them. Towards the end of October 1769, prince Martin Lubomirſki, one of the ſouthern confederates, who had been driven out of Poland, and had taken ſhelter with ſome of his adherents among the mountains of Hungary, got a maniſeſto poſted up on ſeveral of the churches of Cracow, in which he invited the nation to a general revolt, and aſſuring them of the aſſiſtance of the Ottoman Porte, with whom he pretended to have concluded a treaty. This was the beginning of hoſtilities between the Turks and Ruſſians, which were not terminated but by a vaſt effuſion of blood on both ſides.

102 War between this confederacy and the Ruſſians.

The unhappy kingdom of Poland was the firſt ſcene of this war, and in a ſhort time was reduced to the moſt deplorable ſituation. In the end of the year 1768, the peaſants of the Greek religion in the Poliſh Ukraine, and province of Kiow, took up arms, and committed the greateſt ravages, having, as they pretended, been threatened with death by the confederates unleſs they would turn Roman Catholics. Againſt theſe inſurgents the Ruſſians employed their arms, and made great numbers of them priſoners. The reſt took refuge among the Haidamacks; by whom they were ſoon joined, and in the beginning of 1769 entered the Ukraine in conjunction with them, committing everywhere the moſt horrid maſſacres. Here, however, they were at laſt defeated by the Poliſh troops, at the ſame time that ſeveral of the confederacies in Poland were ſeverely chaſtiſed. Soon after, the Chan of the Crim Tartars, having been repulſed with loſs in an attempt on New Servia, entered the Poliſh territories, where he left frightful marks of his inhumanity upon ſome innocent and defenceleſs perſons. This latter piece of conduct, with the cruelties exerciſed by the confederates, induced the Poliſh coſſacks of Braclau and Kiovia, amounting to near 30,000 effective men, to join the Ruſſians, in order to defend their country againſt theſe deſtroyers. Matters continued much in the ſame way during the reſt of the year 1769; and in 1770, ſkirmiſhes frequently happened between the Ruſſians and confederates, in which the latter were almoſt always worſted; but they took care to revenge themſelves by the moſt barbarous cruelties on the diſſidents, wherever they could find them. In 1770, a conſiderable number of the confederates of Bar, who had joined the Turks, and been exceſſively ill uſed by them, came to an accommodation with the Ruſſians, who took them under their protection on very moderate terms.—Agriculture in the mean time had been ſo much neglected, that the crop of 1770 was very deficient. This encouraged a number of deſperadoes to aſſociate under the denomination of *confederates*, who were guilty of ſtill greater exceſſes than thoſe who had been under ſome kind of regulation. Thus a great part of the country was at laſt reduced to a mere deſert, the inhabitants being either exterminated, or carried off to ſtock the remote Ruſſian plantations, from whence they never could return.

103 New confederacies.

In the year 1771, the confederacies, which ſeemed to have been extinguiſhed, ſprung up afreſh, and increaſed to a prodigious degree. This was occaſioned by their having been ſecretly encouraged and ſupplied with money by France. A great number of French officers engaged as volunteers in their ſervice; who, having introduced diſcipline among their troops, they acted with much greater vigour than formerly, and ſometimes proved too hard for their enemies. Theſe gleams of ſucceſs proved at laſt their total ruin. The Ruſſians were reinforced, and properly ſupported. The Auſtrian and Pruſſian troops entered the country, and advanced on different ſides; and the confederates found themſelves in a ſhort time entirely ſurrounded by their enemies, who ſeemed to have nothing leſs in view than an abſolute conqueſt of the country, and ſharing it among themſelves.

104 Attempt to aſſaſſinate the king.

Before matters came to this criſis, however, the confederates formed a deſign of aſſaſſinating the king, on account of his ſuppoſed attachment to the diſſidents. Of this ſingular occurrence we have the following account in the travels of Mr Coxe, communicated to the author by Mr Wraxall.—“A Poliſh nobleman named *Pulaſki*, a general in the army of the confederates, was the perſon who planned the atrocious enterpriſe; and the conſpirators who carried it into execution were about 40 in number, and were headed by three chiefs, named *Lukawſki*, *Strawenſki*, and *Koſinſki*. Theſe three chiefs had been engaged and hired to that purpoſe by Pulaſki, who in the town of Czetſchokow in Great Poland obliged them to ſwear in the moſt ſolemn manner, by placing their hands between his, either to deliver the king alive into his hands, or, in caſe that was impoſſible, to put him to death. The three chiefs choſe 37 perſons to accompany them. On the ſecond of November, about a month after they had quitted Czetſchokow, they obtained admiſſion into Warſaw, unſuſpected or undiſcovered, by the following ſtratagem. They diſguiſed themſelves as peaſants who came to ſell hay, and artfully concealed their ſaddles, arms, and cloathes, under the loads of hay which they brought in waggons, the more effectually to eſcape detection.

105 Who is taken priſoner,

106 And wounded.

“On Sunday night, the third of September 1771, a few of theſe conſpirators remained in the ſkirts of the town; and the others repaired to the place of rendezvous, the ſtreet of the Capuchins, where his majeſty was expected to paſs by about his uſual hour of returning to the palace. The king had been to viſit his uncle prince Czartoriſki, grand chancellor of Lithuania, and was on his return from thence to the palace between nine and ten o'clock. He was in a coach, accompanied by at leaſt 15 or 16 attendants, beſide an aid-de-camp in the carriage: ſcarce was he at the diſtance of 200 paces from prince Czartoriſki's palace, when he was attacked by the conſpirators, who commanded the coachman to ſtop on pain of inſtant death. They fired ſeveral ſhot into the carriage, one of which paſſed through the body of a heyduc, who endeavoured to defend his maſter from the violence of the aſſaſſins. Almoſt all the other perſons who preceded and accompanied his majeſty were diſperſed; the aid-de-camp abandoned him, and attempted to conceal himſelf by flight. Meanwhile the king had opened the door of his carriage with the deſign of effecting his eſcape under ſhelter of the night, which was extremely dark. He had even alighted, when the aſſaſſins ſeized him by the hair, exclaming in Poliſh, with horrible execrations, ‘We have thee now; thy hour is come.’ One of them diſcharged a piſtol at him ſo very near, that he felt the heat of the flaſh; while another cut him acroſs the head with his ſabre, which penetrated to the bone. They then laid hold of his majeſty by the collar, and, mounting on horſeback, dragged him along the ground between their horſes at full gallop for near 500 paces through the ſtreets of Warſaw.

“Soon finding, however, that he was incapable of following them on foot, and that he had already almoſt loſt his reſpiration from the violence with which they had dragged him, they ſet him on horſeback; and then redoubled their ſpeed for fear of being overtaken. When they came to the ditch which ſurrounds Warſaw, they obliged him to leap his horſe over. In the attempt the horſe fell twice, and at the ſecond fall broke its leg. They then mounted his majeſty upon another, all covered as he was with dirt.

207 And rifled.

“ The conſpirators had no ſooner croſſed the ditch, than they began to rifle the king, tearing off the order of the Black Eagle of Pruſſia which he wore round his neck, and the diamond croſs hanging to it. He requeſted them to leave his handkerchief, which they conſented to: his tablets eſcaped their rapacity. A great number of the aſſaſſins retired after having thus plundered him, probably with intent to notify to their reſpective leaders the ſucceſs of their enterpriſe; and the king's arrival as a priſoner. Only ſeven remained with him, of whom Koſinſki was the chief. The night was exceedingly dark; they were abſolutely ignorant of the way; and, as the horſes could not keep their legs, they obliged his majeſty to follow them on foot, with only one ſhoe, the other being loſt in the dirt.

108 His preſence of mind remarkable.

“ They continued to wander through the open meadows, without following any certain path, and without getting to any diſtance from Warſaw. They again mounted the king on horſeback, two of them holding him on each ſide by the hand, and a third leading his horſe by the bridle. In this manner they were proceeding, when his majeſty, finding they had taken the road which led to a village called *Burakow*, warned them not to enter it, becauſe there were ſome Ruſſians ſtationed in that place who might probably attempt to reſcue him (A). Finding himſelf, however, incapable of accompanying the aſſaſſins in the painful poſture in which they held him kept down on the ſaddle, he requeſted them, ſince they were determined to oblige him to proceed, at leaſt to give him another horſe and a boot. This requeſt they complied with; and continuing their progreſs through almoſt impaſſable lands, without any road, and ignorant of their way, they at length found themſelves in the wood of Bielany, only a league diſtant from Warſaw. From the time they had paſſed the ditch they repeatedly demanded of Koſinſki their chief, if it was not yet time to put the king to death; and theſe demands were reiterated in proportion to the obſtacles and difficulties they encountered, till they were ſuddenly alarmed by a Ruſſian patrole or detachment. Inſtantly holding council, four of them diſappeared, leaving him with the other three, who compelled him to walk on. Scarce a quarter of an hour after, a ſecond Ruſſian guard challenged them anew. Two of the aſſaſſins then fled, and the king remained alone with Koſinſki the chief, both on foot. His majeſty, exhauſted with all the fatigue which he had undergone, implored his conductor to ſtop, and ſuffer him to take a moment's repoſe. Koſinſki refuſed it, menacing him with his naked ſabre; and at the ſame time informed him, that beyond the wood they ſhould find a carriage. They continued their walk, till they came to the door of the convent of Bielany. Koſinſki appeared loſt in thought, and ſo much agitated by his reflections, that the king perceiving his diſorder, and obſerving that he wandered without knowing the road, ſaid to him, ‘ I ſee you are at a loſs which way to proceed. Let me enter the convent of Bielany, and do you provide for your own ſafety.’ ‘ No (replied Koſinſki), I have ſworn.’

109 He gains over his conductor, effects his eſcape, and

“ They proceeded till they came to Mariemont, a ſmall palace belonging to the houſe of Saxony, not above half a league from Warſaw: here Koſinſki betrayed ſome ſatisfaction at finding where he was, and the king ſtill demanding an inſtant's repoſe, he conſented at length. They ſat down together on the ground, and the king employed theſe moments in endeavouring to ſoften his conductor, and induce him to favour or permit his eſcape. His majeſty repreſented the atrocity of the crime he had committed in attempting to murder his ſovereign, and the invalidity of an oath taken to perpetrate ſo heinous an action: Koſinſki lent attention to this diſcourſe, and began to betray ſome marks of remorſe. But (ſaid he), if I ſhould conſent and reconduct you to Warſaw, what will be the conſequence? I ſhall be taken and executed! I give you my word (anſwered his majeſty), that you ſhall ſuffer no harm; but if you doubt my promiſe, eſcape while there is yet time. I can find my way to ſome place of ſecurity; and I will certainly direct your purſuers to take the contrary road to that which you have choſen. Koſinſki could not any longer contain himſelf, but, throwing himſelf at the king's feet, implored forgiveneſs for the crime he had committed; and ſwore to protect him againſt every enemy, relying totally on his generoſity for pardon and preſervation. His majeſty reiterated to him his aſſurances of ſafety. Judging, however, that it was prudent to gain ſome aſylum without delay, and recollecting that there was a mill at ſome conſiderable diſtance, he immediately made towards it. Koſinſki knocked, but in vain; no anſwer was given: he then broke a pane of glaſs in the window, and intreated for ſhelter to a nobleman who had been plundered by robbers. The miller refuſed, ſuppoſing them to be banditti, and continued for more than half an hour to perſiſt in his denial. At length the king approached, and ſpeaking through the broken pane, endeavoured to perſuade him to admit them under his roof, adding, ‘ If we were robbers, as you ſuppoſe, it would be very eaſy for us to break the whole window, inſtead of one pane of glaſs.’ This argument prevailed. They at length opened the door, and admitted his majeſty. He immediately wrote a note to General Coccei, colonel of the foot-guards, informing him of his danger and miraculous eſcape.

“ When the meſſenger arrived with the note, the aſtoniſhment and joy was incredible. Coccei inſtantly rode to the mill, followed by a detachment of the guards. He

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(A) “ This intimation, which the king gave to his aſſaſſins, may at firſt ſight appear extraordinary and unaccountable, but was really dictated by the greateſt addreſs and judgment. He apprehended with reaſon, that, on the ſight of a Ruſſian guard, they would inſtantly put him to death with their ſabres, and fly; whereas by informing them of the danger they incurred, he in ſome meaſure gained their confidence: in effect, this behaviour of the king ſeemed to ſoften them a little, and made them believe he did not mean to eſcape from them.”

He met Koſinſki at the door with his ſabre drawn, who admitted him as ſoon as he knew him. The king had ſunk into a ſleep, cauſed by his fatigue; and was ſtretched on the ground, covered with the miller's cloak. Coccei immediately threw himſelf at his majeſty's feet, calling him his ſovereign, and kiſſing his hand. It is not eaſy to paint or deſcribe the aſtoniſhment of the miller and his family, who inſtantly imitated Coccei's example, by throwing themſelves on their knees (B). The king returned to warſaw in General Coccei's carriage, and reached the palace about five in the morning. His wound was found not to be dangerous; and he ſoon recovered the bruiſes and injuries which he had ſuffered during this memorable night. So extraordinary an eſcape is ſcarce to be paralleled in hiſtory, and affords ample matter of wonder and ſurpriſe.

"It is natural to inquire what is become of Koſinſki, the man who ſaved his majeſty's life, and the other conſpirators. He was born in the palatinate of Cracow, and of mean extraction; having aſſumed the name of *Koſinſki*, (C), which is that of a noble family, to give himſelf credit. He had been created an officer in the troops of the confederates under Pulaſki. It would ſeem as if Koſinſki began to entertain the idea of preſerving the king's life from the time when Lukawſki and Strawenſki abandoned him; yet he had great ſtruggles with himſelf before he could reſolve on this conduct, after the ſolemn engagements into which he had entered. Even after he had conducted the king back to Warſaw, he expreſſed more than once his doubts of the propriety of what he had done, and ſome remorſe for having deceived his employers. He was detained under a very ſtrict confinement, and obliged to give evidence againſt his two companions Lukawſki and Strawenſki, who were beheaded, his majeſty having obtained for them from the diet a mitigation of the horrible puniſhment which the laws of Poland inflict upon regicides. About a week after the execution of theſe conſpirators, Koſinſki was ſent out of Poland, after the king had ſettled upon him an annual penſion which he enjoyed at Semigallia in the papal territories."

110
Is received at Warſaw with demonſtrations of joy.

Upon the king's return to Warſaw he was received with the utmoſt demonſtrations of joy. Every one exclaimed with rapture, "The king is alive!" and all ſtruggled to get near him, to kiſs his hand, or even to touch his clothes. But neither the virtues nor the popularity of the ſovereign could allay the factious ſpirit of the Poles, nor prevent the diſmemberment of his kingdom.

111
Partition of Poland projected by the king of Pruſſia.

"The partition of Poland was firſt projected by the king of Pruſſia. Poliſh or Weſtern Pruſſia had long been an object of his ambition: excluſive of its fertility, commerce, and population, its local ſituation rendered it highly valuable to that monarch; it lay between his German dominions and Eaſtern Pruſſia, and while poſſeſſed by the Poles, cut off at their will all communication between them." The period was now arrived when the ſituation of Poland ſeemed to promiſe the eaſy acquiſition of this valuable province. "Frederic purſued it, however, with all the caution of an able politician. On the commencement of the troubles, he ſhowed no eagerneſs to interfere in the affairs of this country; and although he had concurred with the empreſs of Ruſſia in raiſing Staniſlaus Auguſtus to the throne of Poland, yet he declined taking any active part in his favour againſt the confederates. Afterwards, when the whole kingdom became convulſed throughout with civil commotions (1769), and deſolated likewiſe by the plague, he, under pretence of forming lines to prevent the ſpreading of the infection, advanced his troops into Poliſh Pruſſia, and occupied that whole diſtrict.

112
Who gains over the emperor and the empreſs to his meaſures.

"Though now completely maſter of the country, and by no means apprehenſive of any formidable reſiſtance from the diſunited and diſtracted Poles, yet, as he was well aware that the ſecurity of his new acquiſition depended upon the acquieſcence of Ruſſia and Auſtria, he planned the partition of Poland. He communicated the project to the emperor, either upon their interview at Nieſs in Sileſia in 1769, or in that of the following year at Neuſtadt in Auſtria; from whom the overture met with a ready concurrence. To induce the empreſs of Ruſſia to acquieſce in the ſame project, he diſpatched his brother Henry to Peterſburg, who ſuggeſted to the empreſs that the houſe of Auſtria was forming an alliance with the Porte, with which ſhe was then at war; that if ſuch alliance took place, it would create a moſt formidable combination againſt her; that, nevertheleſs, the friendſhip of that houſe was to be purchaſed by acceding to the partition; that upon this condition the emperor was willing to renounce his connection with the Grand Signior, and would ſuffer the Ruſſians to proſecute the war without interruption. Catharine, anxious to puſh her conqueſts againſt the Turks, and dreading the interpoſition of the emperor in that quarter; perceiving likewiſe, from the intimate union between the courts of Vienna and Berlin, that it would not be in her power, at the preſent juncture, to prevent the intended partition—cloſed with the propoſal, and ſelected no inconſiderable portion of the Poliſh territories for herſelf. The treaty was ſigned at Peterſburg in the beginning of February 1772, by the Ruſſian, Auſtrian, and Pruſſian plenipotentiaries. It would be tedious to enter into a detail of the pleas urged by the three powers in favour of their ſeveral demands; it would be no leſs unintereſting to lay before the reader the anſwers and remonſtrances of the king and ſenate, as well as the appeals to the other ſtates which had guaranteed the poſſeſſions of Poland. The courts of London, Paris, Stockholm, and Copenhagen, remonſtrated againſt the uſurpations; but remonſtrances without aſſiſtance could be of no effect. Poland ſubmitted to the diſmemberment not without the moſt violent ſtruggles, and now for the firſt time felt and lamented the fatal effects of faction and diſcord.

113
Poland diſmembered.

A diet being demanded by the partitioning powers, in order to ratify the ceſſion of the provinces, it met on the 19th of April 1773; and ſuch was the ſpirit of the members, that, notwithſtanding the deplorable ſituation of

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(B) "I have been (ſays Mr Wraxall) at this mill, rendered memorable by ſo ſingular an event. It is a wretched Poliſh hovel, at a diſtance from any houſe. The king has rewarded the miller to the extent of his wiſhes in building him a mill upon the Viſtula, and allowing him a ſmall penſion."

(C) His real name was John Kutſma.

of their country, the threats and bribes of the three powers, the partition-treaty was not carried through without much difficulty. For ſome time the majority of the nuncios appeared determined to oppoſe the diſmemberment, and the king firmly perſiſted in the ſame reſolution. The ambaſſadors of the three courts enforced their requiſitions by the moſt alarming menaces, and threatened the king with depoſition and impriſonment. They alſo gave out by their emiſſaries, that in caſe the diet continued refractory, Warſaw ſhould be pillaged. This report was induſtriouſly circulated, and made a ſenſible impreſſion upon the inhabitants. By menaces of this ſort, by corrupting the marſhal of the diet, who was accompanied with a Ruſſian guard; in a word, by bribes, promiſes, and threats, the members of the diet were at length prevailed on to ratify the diſmemberment.

114 Provinces ſeized by the three partitioning powers. Of the diſmembered countries, the Ruſſian province is the largeſt, the Auſtrian the moſt populous, and the Pruſſian the moſt commercial. The population of the whole amounts to near 5,000,000 ſouls; the firſt containing 1,500,000, the ſecond 2,500,000, and the third 860,000. Weſtern Pruſſia was the greateſt loſs to Poland, as by the diſmemberment of that province the navigation of the Viſtula entirely depends upon the king of Pruſſia: by the loſs conſequently of this diſtrict a fatal blow was given to the trade of Poland; for his Pruſſian majeſty has laid ſuch heavy duties upon the merchandize paſſing to Dantzic, as greatly to diminiſh the commerce of that town, and to transfer a conſiderable portion of it to Memel and Konigſburgh.

The partitioning powers, however, did leſs injury to the republic by diſmembering its faireſt provinces, than by perpetuating the principles of anarchy and confuſion, and eſtabliſhing on a permanent footing that exorbitant liberty which is the parent of faction, and has proved the decline of the republic. Under pretence of amending the conſtitution, they have confirmed all its defects, and have taken effectual precautions to render this unhappy country incapable of emerging from its preſent deplorable ſtate, as has been lately ſeen in the failure of the moſt patriotic attempt that was perhaps ever made by a king to reform the conſtitution of his kingdom.

115 The kings of Poland originally hereditary. The kings of Poland were anciently hereditary and abſolute; but afterwards became elective and limited, as we find them at this day. In the reign of Louis, towards the end of the 14th century, ſeveral limitations were laid on the royal prerogative. In that of Caſimir IV. who aſcended the throne in 1446, repreſentatives from the ſeveral palatinates were firſt called to the diet; the legiſlative power till then having been lodged in the ſtates, and the executive in the king and ſenate.

116 Afterwards elective. On the deceaſe of Sigiſmund Auguſtus, it was enacted by law, "That the choice of a king for the future ſhould perpetually remain free and open to all the nobles of the kingdom;" which law has accordingly been hitherto obſerved.

Univerſal Hiſtory. "As ſoon as the throne is vacant, all the courts of juſtice, and other ordinary ſprings of the machine of government, remain in a ſtate of inaction, and all the authority is transferred to the primate, who, in quality of interrex, has in ſome reſpects more power than the king himſelf; and yet the republic takes no umbrage at it, becauſe he has not time to make himſelf formidable. He notifies the vacancy of the throne to foreign princes, which is in effect proclaiming that a crown is to be diſpoſed of; he iſſues the *univerſalia*, or circular letters for the election; gives orders to the ſtaroſts (a ſort of military officers who have great authority, and whoſe proper buſineſs it is to levy the revenue) to keep a ſtrict guard upon the fortified places, and to the grand-generals to do the ſame upon the frontiers, towards which the army marches.

117 Place and manner of the election. "The place of election is the field of Wola, at the gates of Warſaw. All the nobles of the kingdom have a right of voting. The poles encamp on the left ſide of the Viſtula, and the Lithuanians on the right, each under the banners of their reſpective palatinates, which makes a ſort of civil army; conſiſting of between a hundred and fifty and two hundred thouſand men, aſſembled to exerciſe the higheſt act of freedom. Thoſe who are not able to provide a horſe and a ſabre ſtand behind on foot, armed with ſcythes, and do not ſeem at all leſs proud than the reſt, as they have the ſame right of voting.

"The field of election is ſurrounded by a ditch with three gates in order to avoid confuſion, one to the eaſt for Great Poland, another to the ſouth for Little Poland, and a third to the weſt for Lithuania. In the middle of the field, which is called *Kolau*, is erected a great building of wood, named the ſzopa or hall for the ſenate, at whoſe debates the deputies are preſent, and carry the reſult of them to the ſeveral palatinates. The part which the marſhal acts upon this occaſion is very important; for, being the mouth of the nobility, he has it in his power to do great ſervice to the candidates; he is alſo to draw up the inſtrument of election, and the king elect muſt take it only from his hand.

"It is prohibited, upon pain of being declared a public enemy, to appear at the election with regular troops, in order to avoid all violence. But the nobles, who are always armed with piſtols and ſabres, commit violence againſt one another, at the time that they cry out 'liberty!'

"All who aſpire openly to the crown are expreſsly excluded from the field of election, that their preſence may not conſtrain the voters. The king muſt be elected *nemine contradicente*, by all the ſuffrages without exception. The law is founded upon this principle, that when a great family adopts a father all the children have a right to be pleaſed. The idea is plauſible in ſpeculation; but if it was rigorouſly kept to, Poland could have no ſuch thing as a lawful king. They therefore give up a real unanimity, and content themſelves with the appearance of it; or rather, if the law, which preſcribes it, cannot be fulfilled by means of money, they call in the aſſiſtance of the ſabre.

"Before they come to this extremity, no election can poſſibly be carried on with more order, decency, and appearance of freedom. The primate in few words recapitulates to the nobles on horſeback the reſpective merit of the candidates; he exhorts them to chooſe the moſt worthy, invokes heaven, gives his bleſſing to the aſſembly, and remains alone with the marſhal of the diet, while the ſenators diſperſe themſelves into the ſeveral palatinates, to promote an unanimity of ſentiments. If they ſucceed, the primate goes himſelf to collect the votes, naming once more all the candidates: 'Szoda (anſwer the nobles), that is the man we chooſe;'

and inſtantly the air reſounds with his name, with cries of *vivat*, and the noiſe of piſtols. If all the palatines agree in their nominations, the primate gets on horſeback; and then the profoundeſt ſilence ſucceeding to the greateſt noiſe, he aſks three times if all are ſatisfied? and after a general approbation, three times proclaims the king; and the grand-marſhal of the crown repeats the proclamation three times at the three gates of the camp. How glorious a king this, if endued with royal qualities! and how inconteſtible his title in the ſuffrages of a whole people! But this ſketch of a free and peaceable election is by no means a repreſentation of what uſually happens. The corruption of the great, the fury of the people, intrigues and factions, the gold and the arms of foreign powers, frequently fill the ſcene with violence and blood."

118 The pacta conventa.

Before the king is proclaimed, the *pacta conventa* is read aloud to him, which on his knees at the altar he ſwears to obſerve. As this contract, which is drawn up, methodized, and approved, by the ſenate and nobility, may be deemed the great charter of Poland, we ſhall enumerate the principal articles of which it conſiſts. Theſe are, that the king ſhall not attempt to encroach on the liberty of the people, by rendering the crown hereditary in his family; but that he ſhall preſerve all the cuſtoms, laws, and ordinances, reſpecting the freedom of election: that he ſhall ratify all treaties ſubſiſting with foreign powers which are approved by the diet: that it ſhall be his chief ſtudy to cultivate peace, preſerve the public tranquillity, and promote the intereſt of the realm: that he ſhall not coin money except in the name of the republic, nor appropriate to himſelf the advantages ariſing from coinage: that in declaring war, concluding peace, making levies, hiring auxiliaries, or admitting foreign troops upon any pretext within the Poliſh dominions, the conſent of the diet and ſenate ſhall be neceſſary: that all offices and preferments ſhall be given to the natives of Poland and Lithuania; and that no pretence ſhall excuſe or palliate the crime of introducing foreigners into the king's council or the departments of the republic: that the officers of his majeſty's guards ſhall be Poles or Lithuanians; and that the colonel ſhall abſolutely be a native of Poland, and of the order of nobility: that all the officers ſhall be ſubordinate to the authority of the mareſchal: that no individual ſhall be veſted with more employments than the law allows: that the king ſhall not marry without the approbation of the ſenate; and that the houſehold of the queen ſhall be determined and regulated by the republic: that the ſovereign ſhall never apply his private ſignet to acts and papers of a public nature: that the king ſhall diſpoſe of the offices both of the court and of the republic; and regulate with the ſenate the number of forces neceſſary for the defence of the kingdom: that he ſhall adminiſter juſtice by the advice of the ſenate and his council: that the expences of his civil liſt ſhall be the ſame with thoſe of his predeceſſors: that he ſhall fill up all vacancies in the ſpace of ſix weeks: that this ſhall be his firſt buſineſs in the diet, obliging the chancellor to publiſh his appointments in due form: that the king ſhall not diminiſh the treaſure kept at Cracow; but, on the contrary, endeavour to augment that and the number of the crown-jewels: that he ſhall borrow no money without the conſent of the diet: that he ſhall not equip a naval force without the conſent and full approbation of the republic: that he ſhall profeſs the Roman Catholic faith, promote, maintain, and defend it, through all the Poliſh dominions: and finally, that all their ſeveral liberties, rights, and privileges, ſhall be preſerved to the Polanders and Lithuanians in general, and to all the diſtricts and provinces contained within each of theſe great diviſions, without change, alteration, or the ſmalleſt violation, except by the conſent of the republic. To theſe articles a variety of others are added, according to circumſtances and the humour of the diet; but what we have recited form the ſtanding conditions, which are ſcarce ever altered or omitted.

119 The diet of Poland, and

The diet of Poland is compoſed of the king, the ſenate, biſhops, and the deputies of the nobility or gentry of every palatinate, called, in the collective capacity, *comitia togata*; that is, when the ſtates aſſemble in the city without arms and horſes; or *comitia paludata*, when they meet in the fields armed, as during an interregnum, at the diet of election. It is a prerogative of the crown to aſſemble the diet at any particular place, except on occaſion of a coronation, which the cuſtom of the country requires ſhould be celebrated at the capital. For a number of years, indeed, the diet regularly aſſembled at Warſaw; but, on complaint made by the Lithuanians, it was agreed, that every third diet ſhould be held at Grodno. "When it is propoſed to hold a general diet, the king, or, in caſe of an interregnum, the primate, iſſues writs to the palatines of the ſeveral provinces, ſpecifying the time and place of the meeting. A ſketch likewiſe is ſent of the buſineſs to be deliberated on by the aſſembly; the ſenate is conſulted in this particular, and ſix weeks are allowed the members to prepare themſelves for the intended ſeſſion. It is remarkable, that the diet never ſits more than ſix weeks in the moſt critical conjunctures and preſſing emergencies: they have been known to break up in the middle of an important debate, and to leave the buſineſs to a future meeting. This cuſtom hath been juſtly eſteemed one of the greateſt defects of the Poliſh conſtitution, which probably owes its origin to convenience, but is now ſuperſtitiouſly obſerved from whim and caprice. On receipt of the king's writ, the palatine communicates the meeting of the diet to all the caſtellans, ſtaroſtas, and other inferior officers and gentry within his juriſdiction, requiring them to aſſemble on a certain day to elect deputies, and take into conſideration the buſineſs ſpecified in the royal ſummons. 120 Dietines. Theſe meetings are called *petty diets*, *dietines*, or *lantage*, in the language of the country; every gentleman poſſeſſing three acres of land having a vote, and matters being determined by a majority; whereas in the general diet decrees are only valid when the whole body is unanimous. Every palatinate has three repreſentatives, though the buſineſs devolves on one called a *nuncio*, who is elected for his ability and experience; and the other two are added only to give weight to this leading member, and do honour by their magnificent appearance to the palatinate they repreſent. As theſe deputies, ſince the reign of Caſimir III. have ſeats in the diet, it naturally divides the general aſſembly into two bodies, the upper and lower; the one being compoſed of the ſenate, the ſuperior clergy, and the great officers; the other of the repreſentatives of the palatinates, who prepare all buſineſs for the ſuperior body.

"The firſt buſineſs of the aſſembly is to chooſe a mareſchal; upon which occaſion the debates and tumults run ſo high, that the whole time for the ſeſſion of the diet is often conſumed in altercation and wrangling about the election of a ſpeaker, who has now nothing farther to do than return quietly to his own home. After his election, he kiſſes the king's hand; and the chancellor, as the royal repreſentative, reports the matters to be deliberated by the diet. Then the mareſchal acquaints the king with the inſtructions of the deputies from their conſtituents, the grievances which they would have redreſſed, and the abuſes they require to be remedied. He likewiſe requeſts of his majeſty to fill up the vacant offices and benefices, according to law; and he is anſwered by a ſet ſpeech from the chancellor, who reports the king's inclination to ſatisfy his people, as ſoon as he hath conſulted his faithful ſenate.

121 Abſurd cuſtoms obſerved in the diet.

There is ſomething very peculiarly abſurd in ſome of the cuſtoms obſerved by the Poliſh diet: one in particular merits attention. Not only an unanimity of voices is neceſſary to paſs any bill, and conſtitute a decree of the diet, but every bill muſt likewiſe be aſſented to unanimouſly, or none can take effect.

122 The liberum veto.

Thus, if out of twenty bills one ſhould happen to be oppoſed by a ſingle voice, called *liberum veto*, all the reſt are thrown out, and the diet meets, deliberates, and debates, for ſix weeks to no purpoſe.

"To add to the other inconveniences attending the conſtitution of the diet of Poland, a ſpirit of venality in the deputies, and a general corruption, hath ſeized all ranks and degrees in that aſſembly. Here, as in ſome other countries, the cry of liberty is kept up for the ſake of private intereſt. Deputies come with a full reſolution of profiting by their patriotiſm, and not lowering their voice without a gratification. Determined to oppoſe the moſt ſalutary meaſures of the court, they either withdraw from the aſſembly, proteſt againſt all that ſhall be tranſacted in their abſence, or elſe excite ſuch a clamour as renders it neceſſary for the court to ſilence them by ſome lucrative penſion, donation, or employment. Thus not only the buſineſs of the aſſembly is obſtructed by its own members, but frequently by largeſſes from neighbouring powers, and ſometimes by the liberality of an open enemy, who has the art of diſtributing his money with deſcretion.

123 The ſenate of Poland.

"Perhaps the moſt reſpectable department of the Poliſh government is the ſenate, compoſed of the biſhops, palatines, caſtellans, and ten officers of ſtate, who derive a right from their dignities of ſitting in that aſſembly; in all amounting to 144 members, who are ſtyled *ſenators of the kingdom* or *counſellors of the ſtate*, and have the title of *excellency*, a dignity ſupported by no penſion or emoluments neceſſarily annexed. The ſenate preſides over the laws, is the guardian of liberty, the judge of right, and the protector of juſtice and equity. All the members, except the biſhops, who are ſenators *ex officio*, are nominated by the king, and they take an oath to the republic before they are permitted to enter upon their functions. Their honours continue for life: at the general diet they ſit on the right and left of the ſovereign, according to their dignity, without regard to ſeniority. They are the mediators between the monarch and the ſubject, and, in conjunction with the king, ratify all the laws paſſed by the nobility. As a ſenator is bound by oath to maintain the liberties of the republic, it is thought no diſreſpect to majeſty that they remind the prince of his duty. They are his counſellors, and this freedom of ſpeech is an inſeparable prerogative of their office."

Such was the conſtitution of Poland before it was new-modelled by the partitioning powers. That it was a very bad conſtitution needs no proof; but thoſe foreign reformers did not improve it. For two centuries at leaſt, the Poles have with great propriety denominated their government a republic, becauſe the king is ſo exceedingly limited in his prerogative, that he reſembles more the chief of a commonwealth than the ſovereign of a powerful monarchy.

124 The permanent council.

That prerogative, already too confined to afford protection to the peaſants, groaning under the ariſtocratic tyranny of the nobles, was, after the partition treaty, ſtill further reſtrained by the eſtabliſhment of the *permanent council*, which was veſted with the whole executive authority, leaving to the ſovereign nothing but the name. The permanent council conſiſts of 36 perſons, elected by the diet out of the different orders of nobility; and though the king, when preſent, preſides in it, he cannot exert a ſingle act of power but with the conſent of the majority of perſons, who may well be called his *colleagues*.

That the virtuous and accompliſhed Staniſlaus ſhould labour to extricate himſelf and the great body of the people from ſuch unparalleled oppreſſion, and that the more reſpectable part of the nation ſhould wiſh to give to themſelves and their poſterity a better form of government, was ſurely very natural and very meritorious. The influence of the partitioning powers was indeed exerted to make the king contented with his ſituation. His revenues, which before did not exceed L. 100,000, were now increaſed to three times that ſum. The republic likewiſe agreed to pay his debts, amounting to upwards of L. 400,000. It beſtowed on him alſo, in hereditary poſſeſſion, four ſtaroſties, or governments of caſtles, with the diſtricts belonging to them; and reimburſed him of the money he had laid out for the ſtate. It was alſo agreed, that the revenues of the republic ſhould be enhanced to 33 millions of florins (near two millions Sterling), and the army ſhould conſiſt of 30,000 men. Soon after the concluſion of the peace with Turky, the empreſs of Ruſſia alſo made the king a preſent of 250,000 rubles, as a compenſation for that part of his dominions which fell into her hands.

125 A new conſtitution eſtabliſhed in 1791.

Theſe bribes, however, were not ſufficient to blind the eyes of Staniſlaus, or to cool the ardour of his patriotiſm. He laboured for poſterity, and with ſuch apparent ſucceſs, that on the 3d of May 1791, a new conſtitution of the government of Poland was eſtabliſhed by the king, together with the confederate ſtates aſſembled in double number to repreſent the Poliſh nation. That this was a perfect conſtitution, we are far from thinking; but it was probably as perfect as the inveterate prejudices of the nobles would admit of. It deviated as little as poſſible from the old forms, and was drawn up in 11 articles, reſpecting the government of the republic; to which were added 21 ſections, regulating the dietines or primary aſſemblies of Poland.

126 Subſtances of the firſt five articles of it.

Of this conſtitution, the firſt article eſtabliſhed the Roman Catholic faith, with all its privileges and immunities, as the dominant national religion; granting to all other people, of whatever perſuaſion, peace in matters of faith, and the protection of government. The ſecond article guaranteed to the nobility or the equeſtrian order, all the privileges which it enjoyed under the kings of the houſe of Jagellan. The third and fourth articles granted to the free royal towns internal juriſdictions of their own; and exempted the peaſants from ſlavery, declaring every man free as ſoon as he ſets his foot on the territory of the republic. The fifth article, after declaring, that in civil ſociety all power ſhould be derived from the will of the people, enacted that the government of the Poliſh nation ſhould be compoſed of three diſtinct powers, the *legiſlative*, in the ſtates aſſembled; the *executive*, in the king and the council of inſpection; and the *judicial* power, in the juriſdictions exiſting, or to be eſtabliſhed. The ſixth and ſeventh articles, as being of more importance, we ſhall give in the words of the conſtitution itſelf.

127 The diet to conſiſt of two houſes, viz. the houſe of nuncios,

VI. *The Diet*, or *the legiſlative power*, ſhall be divided into two houſes, viz. the houſe of nuncios, or deputies, and the houſe of ſenate, where the king is to preſide. The former being the repreſentative and central point of ſupreme national authority, ſhall poſſeſs the preeminence in the legiſlature; therefore all bills are to be decided firſt in this houſe.

1. *All General Laws*, viz. conſtitutional, civil, criminal, and perpetual taxes; concerning which matters, the king is to iſſue his propoſitions by the circular letters ſent before the dietines to every palatinate and to every diſtrict for deliberation, which coming before the houſe with the opinion expreſſed in the inſtructions given to their repreſentatives, ſhall be taken the firſt for deciſion.

2. *Particular Laws*, viz. temporal taxes; regulations of the mint; contracting public debts; creating nobles, and other caſual recompenſes; reparation of public expences, both ordinary and extraordinary; concerning war; peace; ratification of treaties, both political and commercial; all diplomatic acts and conventions relative to the laws of nations; examining and acquitting different executive departments, and ſimilar ſubjects ariſing from the accidental exigencies and circumſtances of the ſtate; in which the propoſitions, coming directly from the throne into the houſe of nuncios, are to have preference in diſcuſſion before the private bills.

128 And the houſe of ſenate.

In regard to the houſe of ſenate, it is to conſiſt of biſhops, palatines, caſtellans, and miniſters, under the preſidency of the king; who ſhall have but one vote, and the caſting voice in caſe of parity, which he may give either perſonally, or by a meſſage to the houſe. Its power and duty ſhall be,

1. Every general law that paſſes formally through the houſe of nuncios, is to be ſent immediately to this, which is either accepted, or ſuſpended till farther national deliberation, by a majority of votes, as preſcribed by law. If accepted, it becomes a law in all its force; if ſuſpended, it ſhall be reſumed at the next diet; and if it is then agreed to again by the houſe of nuncios, the ſenate muſt ſubmit to it.

3. Every particular law or ſtatute of the diet in matters above ſpecified, as ſoon as it has been determined by the houſe of nuncios, and ſent up to the ſenate, the votes of both houſes ſhall be jointly computed, and the majority, as deſcribed by law, ſhall be conſidered as a decree and the will of the nation. Thoſe ſenators and miniſters who, from their ſhare in executive power, are accountable to the republic, cannot have an active voice in the diet, but may be preſent, in order to give neceſſary explanations to the ſtates.

Theſe ordinary legiſlative diets ſhall have their uninterrupted exiſtence, and be always ready to meet; renewable every two years. The length of ſeſſions ſhall be determined by the law concerning diets. If convened out of ordinary ſeſſion upon ſome urgent occaſion, they ſhall only deliberate on the ſubject which occaſioned ſuch a call, or on circumſtances which may ariſe out of it.

No law or ſtatute enacted by ſuch ordinary diet can be altered or annulled by the ſame. The complement of the diet ſhall be compoſed of the number of perſons in both houſes to be determined hereafter.

The law concerning the dietines or primary elections, as eſtabliſhed by the preſent diet, ſhall be regarded as a moſt eſſential foundation of civil liberty.

129 The liberum veto aboliſhed.

The majority of votes ſhall decide every thing, and every where; therefore we aboliſh, and utterly annihilate, *liberum veto*, all ſorts of confederacies and confederate diets, as contrary to the ſpirit of the preſent conſtitution, as undermining the government, and as being ruinous to ſociety.

130 Extraordinary diet for reviſing the conſtitution.

Willing to prevent, on one hand, violent and frequent changes in the national conſtitution, yet, conſidering on the other, the neceſſity of perfecting it, after experiencing its effects on public proſperity, we determine the period of every 25 years for an extraordinary conſtitutional diet, to be held purpoſely for the reviſion and ſuch alterations of the conſtitution as may be found requiſite: which diet ſhall be circumſcribed by a ſeparate law hereafter.

VII. The moſt perfect government cannot exiſt or laſt without an effectual executive power. The happineſs of the nation depends on juſt laws, but the good effects of laws flow only from their execution. Experience has taught us, that the neglecting this eſſential part of government has overwhelmed Poland with diſaſters.

131 Powers of the king and council of inſpection.

Having, therefore, ſecured to the free Poliſh nation the right of enacting laws for themſelves, the ſupreme inſpection over the executive power, and the choice of their magiſtrates, we entruſt to the king and his council the higheſt power of executing the laws. This council ſhall be called *ſtraz*, or the council of inſpection.

The duty of ſuch executive power ſhall be to watch over the laws, and to ſee them ſtrictly executed according to their import, even by the means of public force ſhould it be neceſſary. All departments and magiſtracies are bound to obey its directions. To this power we leave the right of controuling ſuch as are refractory, or of puniſhing ſuch as are negligent in the execution of their reſpective offices.

This executive power cannot aſſume the right of making laws, or of their interpretation. It is expreſsly forbidden to contract public debts; to alter the repartition of the national income, as fixed by the diet; to declare war; to conclude definitively any treaty, or any diplomatic act; it is only allowed to carry on negociations with foreign courts, and facilitate temporary occurrences, always with reference to the diet.

132 Crown elective in regard to families;

The crown of Poland we declare to be elective in regard to families, and it is ſettled ſo for ever.

Having experienced the fatal effects of interregna, 133 But hereditary in each family till its extinction.

periodically ſubverting government, and being deſirous of preventing for ever all foreign influence, as well as of inſuring to every citizen a perfect tranquillity, we have, from prudent motives, reſolved to adopt hereditary ſucceſſion to our throne: therefore we enact and declare, that, after the expiration of our life, according to the gracious will of the Almighty, the preſent elector of Saxony ſhall reign over Poland, and in his perſon ſhall the dynaſty of future kings of Poland begin. We reſerve to the nation, however, the right of electing to the throne any other houſe or family, after the extinction of the firſt.

134 Coronation oath.

Every king, on his acceſſion to the throne, ſhall take a ſolemn oath to God and the nation, to ſupport the preſent conſtitution, to fulfil the *pacta conventa*, which will be ſettled with the preſent elector of Saxony, as appointed to the crown, and which ſhall bind him in the ſame manner as former ones.

135 King's perſon ſacred:

The king's perſon is ſacred and inviolable; as no act can proceed immediately from him, he cannot be in any manner reſponſible to the nation; he is not an abſolute monarch, but the father and the head of the people; his revenues, as fixed by the *pacta conventa*, ſhall be ſacredly preſerved. All public acts, the acts of magiſtracies, and the coin of the kingdom, ſhall bear his name.

136 His particular powers.

The king, who ought to poſſeſs every power of doing good, ſhall have the right of pardoning thoſe that are condemned to death, except the crimes be againſt the ſtate. In time of war, he ſhall have the ſupreme command of the national forces: he may appoint the commanders of the army, however, by the will of the ſtates. It ſhall be his province to patentee officers in the army, and other dignitaries, conſonant to the regulations hereafter to be expreſſed, to appoint biſhops, ſenators, and miniſters, as members of the executive power.

137 Members of the council of inſpection,

The king's council of inſpection is to conſiſt, 1. Of the primate, as the head of the clergy, and the preſident of the commiſſion of education, or the firſt biſhop *in ordine*. 2. Of five miniſters, viz. the miniſter of police, miniſter of juſtice, miniſter of war, miniſter of finances, and miniſter for the foreign affairs. 3. Of two ſecretaries to keep the protocols, one for the council, another for the foreign department; both, however, without deciſive vote. The hereditary prince coming of age and having taken the oath to preſerve the conſtitution, many aſſiſt at all ſeſſions of the council, but ſhall have no vote therein. The marſhal of the diet, being choſen for two years, has alſo a right to ſit in this council, without taking any ſhare in its reſolves; for the end only to call together the diet, always exiſting, in the following caſe: ſhould he deem, from the emergencies hereunder ſpecified, the convocation of the diet abſolutely neceſſary, and the king refuſing to do it, the marſhal is bound to iſſue his circular letters to all nuncios and ſenators, adducing real motives for ſuch meeting.

138 Powers of the marſhal.

The caſes demanding ſuch convocation of the diet are the following: 1. In a preſſing neceſſity concerning the law of nations, and particularly in caſe of a neighbouring war. 2. In caſe of an internal commotion, menacing with the revolution of the country, or of a colliſion between magiſtratures. 3. In an evident danger of general famine. 4. In the orphan ſtate of the country, by demiſe of the king, or in caſe of the king's dangerous illneſs. All the reſolutions of the council of inſpection are to be examined by the rules abovementioned. The king's opinion, after that of every member in the council has been heard, ſhall deciſively prevail. Every reſolution of this council ſhall be iſſued under the king's ſignature, counterſigned by one of the miniſters ſitting therein; and thus ſigned, ſhall be obeyed by all executive departments, except in caſes expreſsly exempted by the preſent conſtitution.

Should all the members refuſe their counterſign to any reſolution, the king is obliged to forego his opinion; but if he ſhould perſiſt in it, the marſhal of the diet may demand the convocation of the diet; and if the king will not, the marſhal himſelf ſhall ſend his circular letters as above. Miniſters compoſing this council cannot be employed at the ſame time in any other commiſſion or department.

If it ſhould happen that two thirds of ſecret votes in both houſes demand the changing of any perſon either in the council, or any executive department, the king is bound to nominate another. Willing that the council of inſpection ſhould be reſponſible to the nation for their actions, we decree, that when theſe miniſters are denounced and accuſed before the diet (by the ſpecial committee appointed for examining their proceedings) of any tranſgreſſion of poſitive law, they are anſwerable with their perſons and fortunes. Such impeachments being determined by a ſimple majority of votes, collected jointly from both houſes, ſhall be tried immediately by the comitial tribunal, where the accuſed are to receive their final judgment and puniſhment, if found guilty; or to be honourably acquitted on ſufficient proof of innocence.

139 Commiſſions of education, police, &c.

In order to form a neceſſary organization of the executive power, we eſtabliſh hereby ſeparate commiſſions, connected with the above council, and ſubjected to obey its ordinations. Theſe commiſſions are, 1. of education; 2. of police; 3. of war; 4. of treaſury. It is through the medium of theſe four departments that all the particular orderly commiſſions (D), as eſtabliſhed by the preſent diet, in every palatinate and diſtrict, ſhall depend on, and receive all orders from, the council of inſpection, in their reſpective duties and occurrences.

140 Adminiſtration of juſtice.

The eighth article regulates the adminiſtration of juſtice, beginning with a very ſenſible declaration, that the judicial power is incompatible with the legiſlative, and that it cannot be adminiſtered by the king. It therefore conſtitutes primary courts of juſtice for each palatinate or diſtrict, compoſed of judges choſen at the dietine; and appoints higher tribunals, erected one in each of the three provinces into which the kingdom is divided, with which appeals may be lodged from the primary

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(D) Orderly commiſſions are newly inſtituted; each palatinate and diſtrict chooſes a certain number of commiſſaries; their office laſts two years; their principal duty is to maintain police and good order in their diſtrict; to put into execution decrees and regulations of ſupreme departments; to collect taxes; to keep caſh; to make ſuch payments as aſſigned by the commiſſion of finances; to protect citizens from the military oppreſſion; to furniſh recruits, beſides many other duties of internal management.

mary courts. It appoints likewiſe for the trial of perſons accuſed of crimes againſt the ſtate, one ſupreme general tribunal for all claſſes, called a *comitial tribunal* or court, compoſed of perſons choſen at the opening of every diet. The ninth article provides a regency during the king's minority, in caſe of his ſettled alienation of reaſon, or upon the emergency of his being made a priſoner of war. This regency was to be compoſed of the council of inſpection, with the queen at their head, or, in her abſence, the primate of the kingdom. The tenth article enjoins, that the education of the king's ſons ſhall be entruſted to the king with the council, and a tutor appointed by the ſtates; and the eleventh regulates the army in ſuch a manner, as to prevent it from being employed to overturn the conſtitution.

141
Regency on certain occaſions.

142
The election and duties of nuncios.

The regulation of the dietines contains nothing that can be intereſting to our readers, except what relates to the election and duties of nuncios or repreſentatives to the general diet. And here it is enacted, that perſons having a right to vote are all nobles of the equeſtrian order; *i. e.* 1. All hereditary proprietors of landed property, or poſſeſſed of eſtates by adjudication for a debt, paying territorial tax to government: ſons alſo of ſuch proprietors during the life of their parents, before the ex-diviſion of patrimony. 2. Brothers inheriting eſtates before they have ſhared their ſucceſſion. 3. All mortgages who pay 100 florins (50 ſhillings) of territorial tax per year from their poſſeſſions. 4. All life-holders of lands paying territorial tax to the ſame amount. 5. All nobles in the army poſſeſſed of ſuch qualifying eſtates have a vote in their reſpective diſtricts in time of peace, and properly furloughed by their commanders. 6. Legal poſſeſſion is underſtood to be qualifying when it has been formerly acquired and actually enjoyed for twelve calender months previouſly.

Perſons who have no right to vote are, 1. Thoſe of the equeſtrian order that are not actually poſſeſſed of a property, as deſcribed in the foregoing article. 2. Such as hold royal, eccleſiaſtical, or noble lands, even with right of inheritance, but on condition of ſome duty or payment to their principals, conſequently dependent thereon. 3. Gentry poſſeſſing eſtates on feudal tenure, called *ordynackie*, as being bound to certain perſonal ſervice thereby. 4. All renters of eſtates that have no other qualifying property. 5. Thoſe that have not accompliſhed 18 years of age. 6. *Crimine notati*, and thoſe that are under a decree paſſed in default, even in the firſt inſtance, for having diſobeyed any judicial court.

143
Perſons eligible and not eligible.

Every perſon of the equeſtrian order that pays territorial tax to government for his freehold, let it be ever ſo ſmall, is eligible to all elective offices in his reſpective diſtrict.

Gentlemen actually ſerving in the army, even poſſeſſed of landed hereditary eſtate, muſt have ſerved ſix complete years before they are eligible to the office of a nuncio only. But this condition is diſpenſed with in favour of thoſe that have filled before ſome public function.

Whoever is not perſonally preſent at the dietine; whoever has not completed 23 years of age; whoever has not been in any public function, nor paſſed the biennial office of a commiſſary in the orderly commiſſion; thoſe that are not exempted by law from obligations of *ſcarta bellatus*, which ſubjects all newly nobilitated perſons to certain civil reſtrictions until the next generation; and, laſtly, all thoſe againſt whom may be objected a decree *in contumaciam* in a civil cauſe; are not eligible.

144
Inſtructions to the nuncios,

During the buſineſs of election, the preſident who opened the meeting, with the reſt of the committee, except thoſe who are aſſeſſors, ſhall prepare inſtructions for procedure; and in regard to the propoſitions ſent by the king and the council of inſpection, theſe inſtructions ſhall be worded thus: "Our nuncios ſhall vote *affirmative* to the article *N*;" or, "Our nuncios ſhall vote *negative* to the article *N*," in caſe it is found contrary to the opinion of the dietine: and ſhould any amendment or addition be deemed neceſſary and agreed on, it may be inſerted in the inſtructions at the end of the relative propoſition.

145
Who are accountable to their conſtituents,

At the meeting of the dietines, after the diet has ſat, the nuncios are bound to appear before their conſtituents, and to bring their report of the whole proceedings of that aſſembly; firſt, reſpecting the acts of legiſlature; next, with reſpect to the particular projects of their palatinate or diſtrict recommended to them by the inſtructions.

It is at theſe dietines that nuncios, after they have rendered to their conſtituents a clear account of their proceedings and of the diet, may be either confirmed or changed, and new ones elected in their ſtead till the general election for the following ordinary diet.

New nuncios are choſen, 1. In the room of the deceaſed. 2. In the room of thoſe that are become ſenators or miniſters of ſtate. 3. In caſe of reſignation. 4. In the room of ſuch as are diſqualified by the diet. 5. When any of the aſſembly deſires a new election, to ſubſtitute another nuncio in the room of one expreſsly pointed out; which requeſt muſt be made in writing, ſigned by 12 members beſides, and be delivered to the marſhal of the dietine. In this laſt caſe, the marſhal is to read the name of the nuncio objected to, and to make the following propoſition: "Shall the nuncio *N* be confirmed in his function? or, Shall there be a new election made in his ſtead?" The opinion of the meeting being taken by a diviſion, the majority ſhall decide the queſtion, and be declared by the marſhal. If the majority approves the conduct of the nuncio, the marſhal and the aſſeſſors ſhall certify this confirmation on the diploma; and in caſe of diſapprobation, the marſhal ſhall declare the vacancy, and begin the form of a new election.

146
This conſtitution, though ſuperior to the former, proteſted againſt by ſome corrupt nobles,

Such are the outlines of the Poliſh conſtitution eſtabliſhed by the king and the confederates in 1791. It will not bear a compariſon with that under which we have the happineſs to live; but it is ſurely infinitely ſuperior to that motly form of government which for a century paſt, has rendered Poland a perpetual ſcene of war, tumult, tyranny, and rebellion. Many of the corrupt nobles, however, perceiving that it would curb their ambition, deprive them of the baſe means which they had long enjoyed of gratifying their avarice by ſetting the crown to ſale, and render it impoſſible for them to continue with impunity their tyrannical oppreſſion of the peaſants, proteſted againſt it, and withdrew from the confederates. This was nothing more than what might have been expected, or than what the king and his friends undoubtedly did expect. But the malcontents were not ſatisfied with a ſimple proteſt; they preferred their complaints to the empreſs of Ruſſia, 147 And oppoſed by the Ruſſians.

ſia, who, ready on all occaſions, and on the ſlighteſt pretence, to invade Poland, poured her armies into the republic, and ſurrounding the king and the diet with ferocious ſoldiers, compelled them, by the moſt furious and indecent menaces, to undo their glorious labour of love, and to reſtore the conſtitution as ſettled after the partition treaty.

Of the progreſs of the Ruſſians in this work of darkneſs, our readers will be pleaſed with the following manly and indignant narrative, taken from a periodical work * of acknowledged merit.

“It was on the 21ſt of April 1792, that the diet received the firſt notification from the king, of the inimical and unjuſt intentions of Ruſſia. He informed them that, without the ſhadow of pretence, this avowed enemy of the rights of mankind had determined to invade the territory of the republic with an army of 60,000 men. This formidable banditti, commanded by generals Soltikow, Michelſon, and Koſakowſki, was afterwards to be ſupported by a corps of 20,000 and by the troops then acting in Moldavia, amounting to 70,000. The king, however, profeſſed that he was not diſcouraged, and declared his readineſs to put himſelf at the head of the national troops, and to terminate his exiſtence in a glorious conteſt for the liberties of his country. Then, and not before, the diet decreed the organization of the army, and its augmentation to 100,000. The king and the council of inſpection were inveſted with unlimited authority in every thing that regarded the defence of the kingdom. Magazines were ordered to be conſtructed when it was too late, and quarters to be provided for the army.

148 The nation riſes to maintain its independence.

“The diet and the nation roſe as one man to maintain their independence. All private animoſities were obliterated, all private intereſts were ſacrificed; the greateſt encouragements were held forth to volunteers to enroll themſelves under the national ſtandard, and it was unanimouſly decreed by the diet, that all private loſſes ſhould be compenſated out of the public treaſury.

“On the 18th of May, the Ruſſian ambaſſador delivered a declaration, which was worthy of ſuch a cauſe. It was a tiſſue of falſehood and hypocriſy. It aſſerted, that this wanton invaſion, which was evidently againſt the ſenſe of almoſt every individual Polander, was meant entirely for the *good* of the republic. It cenſured the precipitancy with which the new conſtitution was adopted, and aſcribed the ready conſent of the diet to the influence of the Warſaw mob. It repreſented the conſtitution as a violation of the principles on which the Poliſh republic was founded—complained of the licentiouſneſs with which the *ſacred name of the empreſs* was treated in ſome ſpeeches of the members; and concluded by profeſſing, that on theſe accounts, and in behalf of the emigrant Poles, her imperial majeſty had ordered her troops to enter the territories of the republic.

149 Spirit of the nobility.

“At the moment this declaration was delivered to the diet, the Ruſſian troops, accompanied by counts Potocki, Rzewuſki, Branicki, and a few Poliſh apoſtates, appeared upon the frontiers, and entered the territories of the republic in ſeveral columns, before the cloſe of the month. The ſpirit manifeſted by the nobility was truly honourable. Some of them delivered in their plate to the mint. Prince Radzvil engaged voluntarily to furniſh 10,000 ſtand of arms, and another a train of artillery. The courage of the new and haſtily embodied ſoldiers correſponded with the patriotiſm of their nobles. Prince Poniatowſki, nephew to the king, was appointed commander in chief; and though his force was greatly inferior to the enemy, it muſt be confeſſed that he made a noble ſtand. On the 24th of May, the enemy's Coſſacks were repulſed, and purſued by the patroles of the republic to the very entrenchments. On the 26th, about one o'clock, the piquets of the republic diſcovered a large body of Don Coſſacks approaching the outpoſts; and a ſquadron of cavalry, commanded by Lieutenant Kwaſniewſki, ſupported by Lieutenant Golejowſki with two ſquadrons more, in all about 300, marched out to meet them. They attacked the Coſſacks with ſucceſs, but purſued them with more valour than prudence to the ſide of a wood, where they found themſelves drawn into an ambuſcade, and ſurrounded by 2000 horſe, two battalions of chaſſeurs, and ſix pieces of cannon. The intrepid Poles bravely fought their way through the Ruſſian line, and killed upwards of 200 of the enemy. The Poles in this engagement loſt 100 men and two officers; one of whom, Lieutenant Kwaſniewſki, was wounded and made priſoner. The remainder of the detachment reached their quarters in ſafety.

150 Conduct of the court of Berlin.

“Perhaps the hiſtory of man can ſcarcely furniſh an inſtance of perfidy, meanneſs, and duplicity, equal to that which was manifeſted by Pruſſia on this occaſion. By the treaty of defenſive alliance, ſolemnly contracted between the republic of Poland and the king of Pruſſia, and ratified on the 23d of April 1790, it is expreſsly ſtipulated, ‘That the contracting parties ſhall do all in their power to gurantee and preſerve to each other reciprocally the whole of the territories which they reſpectively poſſeſs: That, in caſe of menace or invaſion from any foreign power, they ſhall aſſiſt each other with *their whole force*, if neceſſary:’—and by the ſixth article, it is further ſtipulated, ‘that if any foreign power whatever ſhall preſume to interfere in the internal affairs of Poland, his Pruſſian majeſty ſhall conſider this as a caſe falling within the meaning of the alliance, and ſhall aſſiſt the republic according to the tenor of the fourth article,” that is, with his *whole force*. What then is the pretext for abandoning this treaty? It is, that the *empreſs of Ruſſia has ſhown a decided oppoſition to the order of things eſtabliſhed in Poland on the third of May* 1791, *and is provoked by Poland preſuming to put herſelf into a poſture to defend it.*—It is known, however, by the moſt authentic documents, that nothing, was effected on the third of May 1791, to which Pruſſia had not previouſly aſſented, and which ſhe did not afterwards ſanction; and that Pruſſia, according to the aſſertion of her own king, did not intimate a ſingle doubt reſpecting the revolution till one month (and according to the Pruſſian miniſter till ſix months) after it had taken place; in ſhort, to uſe the monarch's own words as fully explanatory of his double politics, “not till the *general tranquillity of Europe* permitted him to explain himſelf.”——Inſtead, therefore, of aſſiſting Poland, Pruſſia inſultingly recommended to Poland to retrace her ſteps; in which caſe, ſhe ſaid that ſhe would be ready to *attempt an accommodation* in her favour. This attempt was never made, and probably never intended; for the empreſs purſued her meaſures.

The duchy of Lithuania was the great ſcene of action in the beginning of the war; but the Ruſſians had made little

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* New Annual Regiſter, 1792.

151 War with Ruſſia.

little progreſs before the middle of the month of June. On the 10th of that month, General Judycki, who commanded a detachment of the Poliſh troops, between Mire and Swierzna, was attacked by the Ruſſians; but, after a combat of ſome hours, he obliged them to retire with the loſs of 500 men dead on the field.—The general was deſirous of profiting by this advantage, by purſuing the enemy, but was prevented by a moſt violent fall of rain. On the ſucceeding day, the Ruſſians rallied again to the attack; and it then too fatally appeared, that the Poles were too young and undiſciplined to contend with an inferior force againſt experienced troops and able generals. By a maſterly manœuvre, the Ruſſians contrived to ſurround their antagoniſts, at a moment when the Poliſh general ſuppoſed that he had obliged the enemy to retreat; and though the field was conteſted with the utmoſt valour by the troops of the republic, they were at length compelled to give way, and to retire towards Nieſwieſz.

On the 14th another engagement took place near Lubar on the banks of the river Sluez, between a detachment of the Ruſſian grand army and a party of Poliſh cavalry, diſpatched by Prince Joſeph Poniatowſki, to intercept the enemy. The patriotic bravery of the Poles was victorious in this conteſt; but upon reconnoitering the force of the enemy, the prince found himſelf incapable of making a ſucceſsful ſtand againſt ſuch ſuperior numbers. He therefore gave orders to ſtrike the camp at Lubar, and commenced a precipitate retreat. During their march, the Poliſh rear was harraſſed by a body of 4000 Ruſſians, till arriving at Boruſkowee, the wooden bridge unfortunately gave way, under the weight of the cavalry. The enemy, in the mean time, brought their artillery to play upon the rear of the fugitives, who loſt upwards of 250 men. The Poliſh army next directed its courſe toward Zielime, where meeting, on the 17th, with a reinforcement from Zaſlow, it halted to give battle to the enemy. The Ruſſians were upwards of 17,000 ſtrong, with 24 pieces of cannon, and the force of the republic much inferior. After a furious conteſt from ſeven in the morning till five in the afternoon, the Ruſſians were at length obliged to retreat, and leave the field of battle in poſſeſſion of the patriots. The Ruſſians were computed to have loſt 4000 men in this engagement, and the Poles about 1100.

Notwithſtanding theſe exertions, the Poles were obliged gradually to retire before their numerous and diſciplined enemies. Nieſwez, Wilna, Minſk, and ſeveral other places of leſs conſequence, fell into their hands one after another. On a truce being propoſed to the Ruſſian general Kochowſki, the propoſal was haughtily rejected; while the deſertion of vice brigadier Rudnicki and ſome others, who preferred diſhonour to perſonal danger, proclaimed a tottering cauſe. The progreſs of the armies of Catharine was marked with devaſtation and cruelty, while, ſuch was the averſion of the people both to the cauſe and the manner of conducting it, that, as they approached, the country all around became a wilderneſs, and ſcarcely a human being was to be ſeen.

In the mean time, a ſeries of little defeats, to which the inexperience of the commanders, and the intemperate valour of new raiſed troops, appear to have greatly contributed, ſerved at once to diſtreſs and to diſpirit theſe defenders of their country. Prince Poniatowſki continued to retreat, and on the 17th of July, his rear being attacked by a very ſuperior force, it ſuffered a conſiderable loſs, though the ſkill and courage of General Koſciuſko enabled him to make a moſt reſpectable defence. On the 18th, a general engagement took place between the two armies. The Ruſſian line extended oppoſite Dubienka, along the river Bog, as far as Opalin. The principal column, conſiſting of 14,000 men, was chiefly directed againſt the diviſion of General Koſciuſko, which conſiſted of 5000 men only. After a moſt vigorous reſiſtance, in which the Ruſſians loſt upwards of 4000 men, and the troops of the republic only ſome hundreds, the latter was compelled to give way before the ſuperior numbers of the enemy, and to retire further into the country.

152 The king propoſes ſubmiſſion.

This unequal conteſt was at laſt prematurely terminated. The king, whoſe benevolent intentions were, perhaps, overpowered by his mental imbecillity, and whoſe age and infirmities, probably, rendered him unequal to the difficulties and dangers which muſt attend a protracted war, inſtead of putting himſelf, according to his firſt reſolve, at the head of his army, determined, at once, to ſurrender at diſcretion. On the 23d of July, he ſummoned a council of all the deputies at that moment in Warſaw. He laid before them the laſt diſpatches from the empreſs, which inſiſted upon total and unreſerved ſubmiſſion. He pointed out the danger of a diſmemberment of the republic, ſhould they delay to throw themſelves upon the clemency of the empreſs, and to intreat her protection. He mentioned the fatal union of Auſtria and Pruſſia with Ruſſia; and the diſgraceful ſupineneſs maniſeſted by every other court in Europe.

Four citizens, the intrepid and patriotic Malachowſki, the princes Sapieha, Radzvil, and Soltan, vehemently proteſted againſt theſe daſtardly proceedings; and the following evening a company of gentlemen from the different provinces aſſembled for the ſame purpoſe. The aſſembly waited immediately on theſe four diſtinguiſhed patriots, and returned them their acknowledgements for the ſpirit and firmneſs with which they had reſiſted the uſurpations of deſpotiſm. The ſubmiſſion of the king to the deſigns of Ruſſia was no ſooner made known, than Poland was bereft of all her beſt and moſt reſpectable citizens. Malachowſki as marſhal of the diet, and Prince Sapieha grand marſhal of Lithuania, entered ſtrong proteſts on the journals of the diet againſt theſe hoſtile proceedings, and declared ſolemnly that the diet legally aſſembled in 1788 was not diſſolved.

153 Confederation at Warſaw overawed by Ruſſia, reſtores the former conſtitution.

On the ſecond of Auguſt a confederation was formed at Warſaw, of which the grand apoſtate, Potocki, was choſen Marſhall. The acts of this confederation were evidently the deſpotic dictates of Ruſſia, and were calculated only to reſtore the ancient abuſes, and to place the country under the aggravated oppreſſion of a foreign yoke.

It is remarkable, that at the very moment when Poland was ſurrendering its liberties to its deſpotic invaders, the generous ſympathy of Great Britain was evinced, by a liberal ſubſcription, ſupported by all the moſt reſpectable characters in the nation, of every party and of every ſect, for the purpoſe of aſſiſting the king and the republic to maintain their independence. Though the benevolent deſign was fruſtrated, the fact remains on record as a noble teſtimony of the ſpirit of Britons in the cauſe of freedom, of the indignation which fills every liberal heart at the commiſſion of injuſtice, and of the liberality with which they are diſpoſed to aſſiſt thoſe who ſuffer from the oppreſſion of tyrants.

154 The empreſs ſeizes upon part of the Poliſh territory,

Not ſatisfied with reſtoring the old wretched conſtitution, the empreſs of Ruſſia ſeized upon part of the territory which, at the laſt partition, ſhe and her coadjutors had left to the republic; and her ambaſſador entering into the diet with a crowd of armed ruffians, compelled the king and that aſſembly to grant the form of legality to her uſurpations. The nation, however, did not ſubmit. General Koſciuſko kept together a few retainers, whom he was ſoon enabled to augment to the number of an army; and ſeizing on the perſon of the king, he has ever ſince waged againſt Ruſſia a war, of which, it muſt be confeſſed, the object is doubtful. His enemies accuſe him of cheriſhing in the republic the principles of the French Jacobins; and ſome late occurrences give a countenance to the accuſation. Yet it is known he proteſted at firſt that his aim reached no farther than to reſtore the conſtitution of 1791; and if public report may be credited, an inſurrection has lately taken place in Great Poland, or ſouth Pruſſia, in favour of that conſtitution. If other Poles have been driven to democracy, they have only, with the common weakneſs of human nature, run from one extreme to another; and in flying from the tyranny of their invaders, have fallen into the horrors of anarchy. That Koſciuſko will ſucceed againſt the powerful empire of Ruſſia, there is not the ſmalleſt probability: and if there were, the court of Berlin, to complete its character, has withdrawn from the moſt honourable alliance in which it was ever engaged, and ſeems to have employed the ſubſidy which it received from Great Britain for the maintenance of that alliance, to co-operate with the empreſs in annihilating the kingdom and republic of Poland. What will be the ultimate fate of that unhappy country, and its amiable ſovereign, it is impoſſible to ſay; but appearances at preſent indicate a diviſion of the whole territory among the three hoſtile powers who formerly robbed it of ſome of its moſt valuable provinces; and when that diviſion is made, the virtuous Staniſlaus may be removed to a better world by the dagger, by the bowl, by the gripe of a giant, or by a red-hot ſpit!

155 Deplorable ſtate of the country.

156 Air, climate, &c. of Poland.

The air of this kingdom is cold in the north, but temperate in the other parts both in ſummer and winter, and the weather in both more ſettled than in many other countries. The face of the country is for the moſt part level, and the hills are but few. The Crapack or Carpathian mountains ſeparate it from Hungary on the ſouth. The ſoil is very fruitful both in corn and paſturage, hemp and flax. Such is the luxuriance of the paſtures in Podolia, that it is ſaid one can hardly ſee the cattle that are grazing in the meadows. Vaſt quantities of corn are yearly ſent down the Viſtula to Dantzic from all parts of Poland, and bought up chiefly by the Dutch. The eaſtern part of the country is full of woods, foreſts, lakes, marſhes, and rivers; of the laſt of which, the moſt conſiderable in Poland are, the Viſtula, Nieper, Nieſter, Duna, Bog, Warta, and Memel. The metals found in this country are iron and lead, with ſome tin, gold, and ſilver; but there are no mines of the two laſt wrought at preſent. The other products of Poland are moſt ſorts of precious ſtones, ochre of all kinds, fine rock-cryſtal; Muſcovy glaſs, talc, alum, ſaltpetre, amber, pitcoal, quickſilver, ſpar, ſal gem, lapis calaminaris, and vitriol. In Leſſer Poland are ſalt-mines, which are the chief riches of the country, and bring moſt money into the exchequer. In the woods, which conſiſt moſtly of oak, beech, pine, and fir-trees, beſides the more common wild beaſts, are elks, wild aſſes, wild oxen or uri, lynxes, wild horſes, wild ſheep with one horn, biſons, hyænas, wild goats, and buffaloes. In the meadows and fenny ground is gathered a kind of manna; and the kermes-berries produced in Britain are uſed both in dying and medicine.

157 Different claſſes of inhabitants.

The inhabitants conſiſt of nobles, citizens, and peaſants. The firſt poſſeſs great privileges, which they enjoy partly by the indulgence of their kings, and partly by ancient cuſtom and preſcription. Some of them have the title of *prince*, *count*, or *baron*; but no ſuperiority or pre-eminence on that account over the reſt, which is only to be obtained by ſome public poſt or dignity. They have the power of life and death over their vaſſals; pay no taxes; are ſubject to none but the king; have a right to all mines and ſalt-works on their eſtates; to all offices and employments, civil, military, and eccleſiaſtic; cannot be cited or tried out of the kingdom; may chooſe whom they will for their king, and lay him under what reſtraints they pleaſe by the Pacta Conventa; and none but they and the burghers of ſome particular towns can purchaſe lands. In ſhort, they are almoſt entirely independent, enjoying many other privileges and prerogatives beſides thoſe we have ſpecified; but if they engage in trade, they forfeit their nobility.

158 Language.

The Poliſh tongue is a dialect of the Sclavonic: (ſee PHILOLOGY, n° 222.). It is neither copious nor harmonious. Many of the words, as they are written, have not a ſingle vowel in them; but the High Dutch and Latin are underſtood and ſpoken pretty commonly, though incorrectly. The language in Lithuania differs much from that of the other provinces. True learning, and the ſtudy of the arts and ſciences, have been little attended to in Poland, till of late they began to be regarded with a more favourable eye, and to be not only patronized, but cultivated by ſeveral of the nobles and others, both laymen and eccleſiaſtics.

159 Archbiſhoprics, &c.

There are two archbiſhops in the kingdom, viz. thoſe of Gneſna and Laopol, and about a dozen biſhops. The archbiſhop of Gneſna is always a cardinal, and primate of the kingdom. The prevailing religion is Popery, but there are great numbers of Lutherans, Calviniſts, and Greeks, who are called *Diſſidents*, and by the laws of the kingdom were intitled to toleration; but were much oppreſſed till very lately. The Jews are indulged with great privileges, and are very numerous in Poland; and in Lithuania, it is ſaid there are a multitude of Mahometan Tartars. We may judge of the numbers of Jews in this country by the produce of their annual poll-tax, which amounts to near 57,000 rixdollars.

160 Manufactures.

There are few or no manufactures in the kingdom; if we except ſome linen and woollen clothes and hardwares; and the whole trade is confined to the city of Dantzic, and other towns on the Viſtula or Baltic.

161 Revenue.

Before the preſent troubles the king's revenue was all clear to himſelf; for he paid no troops, not even his own guards; but all the forces, as well as the officers of ſtate, were paid by the republic. The public revenues aroſe chiefly from the crown-lands, the ſalt-mines in the palatinate of Cracow, from the rents of Marienburg, Dirſhau, and Regenhus, from the government of Cracow, and diſtrict of Niepolomiez, and from ancient tolls and cuſtoms, particularly thoſe of Elbing and Dantzic. From what ſources thoſe revenues now ariſe, it is difficult to ſay; but Pruſſia has got poſſeſſion of the moſt lucrative cuſtoms.

162 Order of knighthood. The order of the White Eagle was inſtituted by Auguſtus II. in the year 1705. Its enſign is a croſs of gold enamelled with red, and appendant to a blue ribbon. The motto, *Pro fide, rege, et lege*.

163 Forces. The ſtanding forces of Poland are divided into the crown-army, and that of Lithuania, conſiſting of horſe and foot, and amounting to between 20,000 and 30,000 men. Theſe troops are moſtly cantoned on the crown-lands, and in Poland are paid by a capitation or poll-tax; but in Lithuania other taxes are levied for this purpoſe. Moſt of the foot are Germans. On any ſudden and imminent danger, the whole body of the nobility, with their vaſſals, are obliged to appear in the field on horſeback; and the cities and towns furniſh a certain number of foot-ſoldiers, with carriages, and military ſtores: but for want of proper arms, proviſions, ſubordination, and diſcipline, and by being at liberty after a few weeks to return home, this body has proved but of little advantage to the republic. Dantzic is the only place in the Poliſh dominions that deſerves the name of a fortreſs, and it is now in the poſſeſſion of Pruſſia. Foreign auxiliaries are not to be brought into the kingdom, nor the national troops to march out of it, without the conſent of the ſtates.

Such was the military eſtabliſhment of Poland before the partition treaty. What it has been ſince, and is at preſent, we cannot poſitively ſay.

164 Character of the people. The Poles are perſonable men, and have good complexions. They are eſteemed a brave, honeſt people, without diſſimulation, and exceedingly hoſpitable. They clothe themſelves in furs in winter, and over all they throw a ſhort cloak. No people keep grander equipages than the gentry. They look upon themſelves as ſo many ſovereign princes; and have their guards, bands of muſic, and keep open houſes: but the lower ſort of people are poor abject wretches, in the loweſt ſtate of ſlavery. The exerciſes of the gentry are hunting, riding, dancing, vaulting, &c. They reſide moſtly upon their eſtates in the country; and maintain themſelves and families by agriculture, breeding of bees, and grazing.

POLAR, in general, ſomething relating to the poles of the world, or poles of the artificial globes.

Polar Regions, thoſe parts of the world which lie near the north and ſouth poles. See the article POLE.

POLARITY, the quality of a thing conſidered as having poles, or a tendency to turn itſelf into one certain poſture; but chiefly uſed in ſpeaking of the magnet.

POLE (Reginald), cardinal, and archbiſhop of Canterbury, a younger ſon of Sir Rich. Pole, Lord Montague, was born at Stoverton caſtle, in Staffordſhire, in the year 1500. At ſeven years of age he was ſent to a Carthuſian monaſtery at Shene, near Richmond in Surry; and thence, when he was about 12 years old, removed to Magdalen college in Oxford, where, by the inſtructions of the celebrated Lineacre and Latimer, he made conſiderable progreſs in learning. In 1515 he took the degree of bachelor of arts, and was admitted to deacon's orders ſome time after: in 1517, he was made prebendary of Saliſbury, and in 1519 dean of Wimborne and dean of Exeter. We are not ſurprized at this young nobleman's early preferments, when we conſider him as the kinſman of Henry VIII. and that he was bred to the church by the king's ſpecial command.

Being now about the age of 19, he was ſent, according to the faſhion of the times, to finiſh his ſtudies at Padua in Italy, where he reſided ſome time in great ſplendor, having a handſome penſion from the king. He returned to England in 1525, where he was moſt graciouſly received at court, and univerſally admired for his talents and addreſs; but preferring ſtudy and ſequeſtration to the pleaſures of a court, he retired to the Carthuſian convent at Shene, where he had continued about two years, when the pious king began to divulge his ſcruples of conſcience concerning his marriage with Catharine of Spain. Pole foreſaw that this affair would neceſſarily involve him in difficulties; he therefore determined to quit the kingdom, and accordingly obtained leave to viſit Paris. Having thus avoided the ſtorm for the preſent, he returned once more to his convent at Shene; but his tranquillity was again interrupted by the king's reſolution to ſhake off the pope's ſupremacy, of which Pole's approbation was thought indiſpenſably neceſſary. How he managed in this affair, is not very clear. However, he obtained leave to reviſit Italy, and his penſion was continued for ſome time.

The king, having now divorced Queen Catharine, married Anne Boylen, and being reſolved to throw off the papal yoke, ordered Dr Richard Sampſon to write a book in juſtification of his proceedings, which he ſent to Pole for his opinion. To this Pole, ſecure in the pope's protection, wrote a ſcurrilous anſwer, entitled *Pro Unitate Eccleſiaſtica*, and ſent it to the king; who was ſo offended with the contents, that he withdrew his penſion, ſtripped him of all his preferments, and procured an act of attainder to be paſſed againſt him. In the mean time, Pole was created a cardinal, and ſent nuncio to different parts of Europe. King Henry made ſeveral attempts to have him ſecured and brought to England, but without effect. At lengh the pope fixed him as legate at Viterbo, where he continued till the year 1543, when he was appointed legate at the council of Trent, and was afterwards employed by the pope as his chief counſellor.

Pope Paul III. dying in 1549, Pole was twice elected his ſucceſſor, and we are told, twice refuſed the papal dignity: firſt, becauſe the election was made in too great haſte; and the ſecond time, becauſe it was done in the night. This delicacy in a cardinal is truly wonderful: but the intrigues of the French party ſeem to have been the real cauſe of his miſcarriage; they ſtarted many objections to Pole, and by that means gained time to procure a majority againſt him. Cardinal Maria de Monte obtained the triple crown; and Pole, having kiſſed his ſlipper, retired to the convent of Magazune near Verona, where he continued till the death of Edward VI. in the year 1553. On the acceſſion of queen Mary, Pole was ſent legate to England, where he was received by her majeſty with great veneration, and conducted to the archbiſhop's palace at Lambeth, poor Cranmer being at that time priſoner in the tower. He immediately appeared in the Houſe of Lords, where he made a long ſpeech; which being reported to the commons by their ſpeaker, both theſe obſequious houſes concurred in an humble ſupplication to be reconciled to the ſee of Rome. They preſented it on their knees to her majeſty, who interceded with the cardinal, and he graciouſly condeſcended to give them abſolution. This buſineſs being over, the legate made his public entry into London, and immediately ſet about the extirpation of hereſy. The day after the execution of Cranmer, which he is ſaid, though we believe falſely, to have adviſed, he was conſecrated archbiſhop of Canterbury. In the ſame year, 1556, he was elected chancellor of the univerſity of Oxford, and ſoon after of Cambridge; both which he viſited, by his commiſſioners. He died of a double quartan ague in the year 1558, about 16 hours after the death of the queen; and was buried in the cathedral of Canterbury.

As to his character, the Romiſh writers aſcribe to him every virtue under heaven: even Biſhop Burnet is extremely laviſh in his praiſe, and attributes the cruelties of Mary's reign to the advice of Gardiner. In this Mr Hume agrees with the biſhop, and, repreſents Pole as the advocate of toleration. By every impartial account, he ſeems to have been a man of mild manners, and of real worth, though undoubtedly a zealous member of the church of Rome.—He wrote, *Pro unitate eccleſiaſtica, De ejuſdem poteſtate*; A Treatiſe on Juſtification, and various other tracts.

Mr Philips publiſhed a very well written, though a very partial account, of Pole's life, to which Glouceſter Ridley replied. This laſt work, which is intitled a *Review of Mr Philips's Life of Reginald Pole*, was publiſhed in 1766. It is a complete confutation of the former, and is a very learned and temperate vindication of the doctrines of the Reformation.

Pole, in aſtronomy, that point in the heavens round which the whole ſphere ſeems to turn. It is alſo uſed for a point directly perpendicular to the centre of any circle's plane, and diſtant from it by the length of a radius.

Pole, in geography, one of the points on which the terraqueous globe turns; each of them being 90 degrees diſtant from the equator, and, in conſequence of their ſituation, the inclination of the earth's axis, and its paralleliſm during the annual motion of our globe round the ſun, having only one day and one night throughout the year.

1
The poles enjoy much light;

It is remarkable that though the *north* in Hebrew, Greek, Latin, and French, derives its name from gloom, obſcurity, and darkneſs, the poles enjoy more light than any other part of the world. The ancients believed the north to be covered with thick darkneſs; Strabo, tells us, that Homer, by the word σεφος, which properly ſignifies *obſcurity* or *darkneſs*, meant the *north*; and thus Tibullus, ſpeaking of the north, ſays,

> *Illic et denſa tellus abſconditur umbra.*
>
> Paneg. ad Miſſel.

The Arabians call the northern ocean the *dark ſea*; the Latins gave the name of *Aquilo* to the north wind, becauſe *aquilus* ſignifies *black*; and the French call it *la biſe*, from *bis* "black." According to the ancients, the Cimmerians lived in darkneſs, becauſe they were placed near the north. But all this is mere prejudice; for there are no places in the world that enjoy light longer than the arctic and antarctic poles; and this is accounted for by conſidering the nature of twilight. In the torrid zone, and under the line, night immediately follows the ſetting of the ſun, without any ſenſible twilight; whereas the twilight begins and continues increaſing in proportion as places are diſtant from the equator or approach the pole. To this long twilight we muſt add the *aurora borealis*, which appears in the northern regions, Greenland, &c. in clear nights, at the beginning of the new moon, caſting a light equal to that of full moon. See Gaſſendi *in the life of Peyreſc*, book iii. and La Perere in his *Account of Greenland*. There is alſo long moonlight at the poles during winter. See Astronomy, 373. But though there is really more light in the polar regions than elſewhere, yet owing to the obliquity with which the rays of the ſun fall upon them, and the great length of winter night, the cold is ſo intenſe, that thoſe parts of the globe which lie near the poles have never been fully explored, though the attempt has been repeatedly made by the moſt celebrated navigators. Indeed their attemps have chiefly been confined to the northern regions; for with regard to the ſouth pole, there is not the ſame incitement to attempt it. The great object for which navigators have ventured themſelves in theſe frozen ſeas, was to find out a more quick and more ready paſſage to the Eaſt Indies *; and this hath been attempted three ſeveral ways: one by coaſting along the northern parts of Europe and Aſia, called the *north-eaſt paſſage*; another, by ſailing round the northern part of the American continent, called the *north-weſt paſſage*; and the third, by ſailing directly over the pole itſelf.

2
And why.

We have already given a ſhort account of ſeveral unſucceſsful attempts which have been made from England to diſcover the firſt two of theſe. See *North-Weſt Paſſage*, and *North-Eaſt Paſſage*. But before we proceed to the third, we ſhall make a few further obſervations on them, and mention the attempts of ſome other nations.

3
Attempts to find out the north-eaſt paſſage.

During the laſt century, various navigators, Dutchmen particularly attempted to find out the *north-eaſt paſſage*, with great fortitude and perſeverance. They always found it impoſſible, however, to ſurmount the obſtacles which nature had thrown in the way. Subſequent attempts are thought by many to have demonſtrated the impoſſibility of ever ſailing eaſtward along the northern coaſt of Aſia; and this impoſſibility is accounted for by the increaſe of cold in proportion to the extent of land. See America, n° 3—5. This is indeed the caſe in temperate climates; but much more ſo in thoſe frozen regions where the influence of the ſun, even in ſummer, is but ſmall. Hence, as the continent of Aſia extends a vaſt way from weſt to eaſt, and has beſides the continent of Europe joined to it on the weſt, it follows, that about the middle part of that tract of land the cold ſhould be greater than anywhere elſe. Experience has determined this to be fact; and it now appears, that about the middle part of the northern coaſt of Aſia the ice never thaws; neither have even the hardy Ruſſians and Siberians themſelves been able to overcome the difficulties they met with in that part of their voyage. In order to make this the more plain and

4
Why it is impoſſible to ſail along the north-eaſt coaſt of Aſia.

[*] See Cook, p. 395. col. 2.

and the following accounts more intelligible, we ſhall obſerve, that from the north-weſtern extremity of Europe, called the *North Cape*, to the north-eaſtern extremity of Aſia, called the *Promontory of the Tſchutſki**, is a ſpace including about 160 degrees of longitude, *viz.* from 40 to 200 eaſt from Ferro: the port of Archangel lies in about 57 degrees eaſt longitude, Nova Zembla between 70 and 95; which laſt is alſo the ſituation of the mouth of the great river Oby. Still farther eaſtward are the mouths of the rivers Jeniſey in 100°; Piaſida in 105°; Chatanga in 124°; Lena, which has many mouths, between 134° and 142°; Indigirka in 162°; and the Kovyma in 175°. The coldeſt place in all this tract, therefore, ought to be that between the mouths of the Jeniſey and the Chatanga; and indeed here the unſurmountable difficulty has always been, as will appear from the following accounts of the voyages made by the Ruſſians with a view to diſcover the north-eaſt paſſage.

5 Voyage of Morzovieff, &c.

In 1734, lieutenant Morzovieff ſailed from Archangel towards the river Oby, but could ſcarce advance 20 degrees of longitude during that ſeaſon. The next ſummer he paſſed through the ſtraits of Weygatz into the ſea of Kara; but did not double the promontory which ſeparates the ſea of Kara from the bay or mouth of Oby. In 1738, the lieutenants Malgyin and Shurakoff doubled that promontory with great difficulty, and entered the bay of Oby. Several unſucceſsful attempts were made to paſs from the bay of Oby to the Jeniſey; which was at laſt effected, in 1738, by two veſſels commanded by lieutenants Offzin and Koſkeleff. The ſame year the pilot Feodor Menin ſailed eaſtward from the Jeniſey to the mouth of the Piaſida: but here he was ſtopped by the ice; and finding it impoſſible to force a paſſage, he returned to the Jeniſey.

6 Of Prontſhiſtcheff.

In July 1735, lieutenant Prontſhiſtcheff ſailed down the river Lena, in order to paſs by ſea to the mouth of the Jeniſey. The weſtern mouths of the Lena were ſo choaked up with ice, that he was obliged to paſs thro' the moſt eaſterly one; and was prevented by contrary winds from getting out till the 13th of Auguſt. Having ſteered north-weſt along the iſlands which lie ſcattered before the mouths of the Lena, he found himſelf in lat. 70. 4.; yet even here he ſaw pieces of ice from 24 to 60 feet in height, and in no place was there a free channel left of greater breadth than 100 or 200 yards. His veſſel being much damaged, he entered the mouth of the Olenek, a ſmall river near the weſtern mouth of the Lena; and here he continued till the enſuing ſeaſon, when he got out in the beginning of Auguſt. But before he could reach the mouth of the Chatanga, he was ſo entirely ſurrounded and hemmed in with ice, that it was with the utmoſt difficulty he could get looſe. Obſerving then a large field of ice ſtretched into the ſea, he was obliged to ſail up the Chatanga. Getting free once more, he proceeded northward, doubled the cape called *Taimura*, and reached the bay of that name, lying in about 115° eaſt from Ferro; from thence he attempted to proceed weſtward along the coaſt. Near the ſhore were ſeveral ſmall iſlands, between which and the ſhore the ice was immoveably fixed. He then directed his courſe towards the ſea, in order to paſs round the chain of iſlands. At firſt he found the ſea more free to the north of theſe iſlands, but obſerved much ice lying between them. At laſt he arrived at what he took to be the laſt of the iſlands, lying in lat. 77. 25. Between this iſland and the ſhore, as well as on the other ſide of the iſland which lay moſt to the north, the ice was firm and immoveable. He attempted, however, to ſteer ſtill more to the north; and having advanced about ſix miles, he was prevented by a thick fog from proceeding: this fog being diſperſed, he ſaw nothing everywhere but ice, which at laſt drove him eaſtward, and with much danger and difficulty he got to the mouth of the Olenek on the 29th of Auguſt.

7 Of Chariton Laptieff.

Another attempt to paſs by ſea from the Lena to the Jeniſey was made in 1739 by Chariton Laptieff, but with no better ſucceſs than that juſt mentioned. This voyager relates, that between the rivers Piaſida and Taimura, a promontory ſtretches into the ſea, which he could not double, the ſea being entirely frozen up before he could paſs round.

8 Mr Coxe's obſervations.

Beſides the Ruſſians, it is certain that ſome Engliſh and Dutch veſſels have paſſed the iſland of Nova Zembla into the ſea of Kara: "But (ſays Mr Coxe in his Account of the Ruſſian voyages) no veſſel of any nation has ever paſſed round that cape which extends to the north of the Piaſida, and is laid down in the Ruſſian charts in about 78° lat. We have already ſeen that no Ruſſian veſſel has ever got from the Piaſida to the Chatanga, or from the Chatanga to the Piaſida; and yet ſome authors have poſitively aſſerted that this promontory has been ſailed round. In order therefore to elude the Ruſſian accounts, which clearly aſſert the contrary, it is pretended that Gmelin and Muller have purpoſely concealed ſome parts of the Ruſſian journals, and have impoſed on the world by a miſrepreſentation of facts. But without entering into any diſpute upon this head, I can venture to affirm, that no ſufficient proof has been as yet advanced in ſupport of this aſſertion; and therefore, until ſome poſitive information ſhall be produced, we cannot deny plain facts, or give the preference to hearſay evidence over circumſtantial and well atteſted accounts."

9 Of the navigation from the Lena to Kamſchatka.

The other part of this north-eaſt paſſage, *viz.* from the Lena, to Kamſchatka, though ſufficiently difficult and dangerous, is yet practicable; as having been once performed, if we may believe the accounts of the Ruſſians. According to ſome authors indeed, ſays Mr Coxe, this navigation has been open a century and an half; and ſeveral veſſels at different times have paſſed round the north-eaſtern extremity of Aſia. But if we conſult the Ruſſian accounts, we ſhall find that frequent expeditions have been unqueſtionably made from the Lena to the Kovyma, but that the voyage from the Kovyma round Tſchutſkoi Noſs into the Eaſtern Ocean has been performed but once. According to Mr Muller, this formidable cape was doubled in the year 1648. The material incidents of this remarkable voyage are as follow.

10 Voyage of Deſhneff, Ankudinoff, &c.

"In 1648 ſeven kotches, or veſſels ſailed from the mouth of the river Kovyma, in order to penetrate into the Eaſtern Ocean. Of theſe, four were never more heard of: the remaining three were commanded by Simon Deſhneff, Geraſim Ankudinoff, and Fedot Alexeeff. Deſhneff and Ankudinoff quarrelled before their departure concerning the diviſion of profits and honours to be acquired by their voyage; which, however, was not ſo eaſily accompliſhed as they had imagined. Yet

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* See Cook's Diſcoveries n°109, and 118.

Deſhneff in his memorials makes no mention of obſtructions from the ice, nor probably did he meet with any; for he takes notice that the ſea is not every year ſo free from ice as it was at that time. The veſſels ſailed from the Kovyma on the 20th of June, and in September they reached the promontory of the Tſchutſki, where Ankudinoff's veſſel was wrecked, and the crew diſtributed among the other two. Soon after this the two veſſels loſt ſight of each other, and never joined again. Deſhneff was driven about by tempeſtuous winds till October, when he was ſhipwrecked conſiderably to the ſouth of the Anadyr. Having at laſt reached that river, he formed a ſcheme of returning by the ſame way that he had come; but never made the attempt. As for Alexeeff, after being alſo ſhipwrecked, he had died of the ſcurvy, together with Ankudinoff; part of the crew were killed by the ſavages, and a few eſcaped to Kamſchatka, where they ſettled."

* See Cook's Diſcoveries, n° 95—100.

From Captain * Cook's voyage towards the north-eaſtern parts of Aſia, it appears, that it is poſſible to double the promontory of Tſchutſki without any great difficulty: and it now appears, that the continents of Aſia and America are ſeparated from one another but by a narrow ſtrait, which is free from ice; but, to the northwards, that experienced navigator was everywhere ſtopped by ice in the month of Auguſt, ſo that he could neither trace the American continent farther than to the latitude of 70°, nor reach the mouth of the river Kovyma on the Aſiatic continent; though it is probable that this might have been done at another time when the ſituation of the ice was altered either by winds or currents.

11 Inſurmountable obſtacles in the north-eaſt paſſage.

On the whole, therefore, it appears that the inſurmountable obſtacle in the north-eaſt paſſage lies between the rivers Piaſida and Chatanga; and unleſs there be in that ſpace a connection between the Aſiatic and American continents, there is not in any other part. Ice, however, is as effectual an obſtruction as land: and though the voyage were to be made by accident for once, it never could be eſteemed a paſſage calculated for the purpoſes of trade, or any other beneficial purpoſe whatever.

12 Of the north weſt paſſage.

With regard to the north-weſt paſſage, the ſame difficulties occur as in the other. Captain Cook's voyage has now aſſured us, that if there is any ſtrait which divides the continent of America into two, it muſt lie in a higher latitude than 70°, and conſequently be perpetually frozen up. If a north-weſt paſſage can be found then, it muſt be by ſailing round the whole American continent, inſtead of ſeeking a paſſage through it, which ſome have ſuppoſed to exiſt in the bottom of Baffin's Bay. But the extent of the American continent to the northward is yet unknown; and there is a poſſibility of its being joined to that part of Aſia between the Piaſida and Chatanga, which has never yet been circumnavigated*. It remains therefore to conſider, whether there is any poſſibility of attaining the wiſhed for paſſage by ſailing directly north, between the eaſtern and weſtern continents.

* See Cook's Diſcoveries, n° 11.

13 Barrington's arguments in favour of a poſſibility of reaching the pole.

Of the practicability of this method, the Honourable Daines Barrington is very confident, as appears by ſeveral tracts which he publiſhed in the years 1775 and 1776, in conſequence of the unſucceſsful attempts made by Captain Phipps, now Lord Mulgrave. See *North-Eaſt Paſſage*, p. 108. col. 1. top of the page.—In theſe tracts he inſtances a great number of navigators who have reached very high northern latitudes; nay, ſome who have been at the pole itſelf, or gone beyond it.—Theſe inſtances are, 1. One Captain Thomas Robertſon aſſured our author, that he had been in latitude 82½, that the ſea was open, and he was certain that he could have reached the latitude of 83°.—2. From the teſtimony of Captain Cheyne, who gave anſwers to certain queries drawn up by Mr Dalrymple concerning the polar ſeas, it appears that he had been in the latitude of 82°.—3. One Mr Watt informed our author, that when he was 17 years of age, at that time making his firſt voyage with Captain M'Callam, a bold and ſkilful navigator, who commanded a Scotch whale-fiſhing ſhip, as during the time that the whales are ſuppoſed to copulate no fiſhing can be carried on, the captain reſolved to employ that interval in attempting to reach the north pole. He accordingly proceeded without the leaſt obſtruction to 83½, when the ſea was not only open to the northward, but they had ſeen no ice for the laſt three degrees; but while he ſtill advanced, the mate complained that the compaſs was not ſteady, and the captain was obliged with reluctance to give over his attempt.—4. Dr Campbell, the continuator of Harris's voyages, informed Mr Barrington, that Dr Dallie, a native of Holland, being in his youth aboard a Dutch ſhip of war which at that time was uſually ſent to ſuperintend the Greenland fiſhery, the captain determined, like the Scotchman abovementioned, to make an attempt to reach the pole during the interval between the firſt and ſecond fiſheries. He penetrated, according to the beſt of Dr Campbell's recollection, as far as 88°; when the weather was warm, the ſea free from ice, and rolling like the bay of Biſcay. Dallie now preſſed the captain to proceed: but he anſwered, that he had already gone too far, and ſhould be blamed in Holland for neglecting his ſtation; upon which account he would ſuffer no journal to be kept, but returned as ſoon as poſſible to Spitſbergen.—5. In the year 1662-3, Mr Oldenburg, then ſecretary of the Royal Society, was ordered to regiſter a paper, entitled "Several inquiries concerning Greenland, anſwered by Mr Gray, who had viſited theſe parts." The 19th of theſe queries is the following: How near hath any one been known to approach the pole?—The anſwer is, "I once met upon the coaſt of Greenland a Hollander that ſwore he had been half a degree from the pole, ſhowing me his journal, which was alſo atteſted by his mate; where they had ſeen no ice or land, but all water."—6. In Captain Wood's account of a voyage in queſt of the north-eaſt paſſage, we have the following account of a Dutch ſhip which reached the latitude of 89°. "Captain Goulden, who had made above 30 voyages to Greenland, did relate to his majeſty, that being at Greenland ſome 20 years before, he was in company with two Hollanders to the eaſtward of Edge's iſland; and that the whales not appearing on the ſhore, the Hollanders were determined to go farther north[illegible]rd; and in a fortnight's time returned, and gave it out that they had ſailed into the latitude 89°, and that they did not meet with any ice, but a free and open ſea, and that there run a very hollow *grown* ſea like that of the Bay of Biſcay. Mr Goulden being not ſatisfied with the bare relation, they produced him four journals out of the two ſhips, which teſtified the ſame, and that they all agreed within four minutes."

minutes."—7. In the Philoſophical Tranſactions for 1675 we have the following paſſage: "For it is well known to all that ſail northward, that moſt of the northern coaſts are frozen up for many leagues, though in the open ſea it is not ſo, *no nor under the pole itſelf*, unleſs by accident." In which paſſage the having reached the pole is alluded to as a known fact, and as ſuch ſtated to the Royal Society.—8. Mr Miller, in his Gardener's Dictionary, mentions the voyage of one Captain Johnſon, who reached 88 degrees of latitude. Mr Barrington was at pains to find a full account of this voyage; but met only with the following paſſage in Buffon's Natural Hiſtory, which he takes to be a confirmation of it. "I have been aſſured by perſons of credit, that an Engliſh captain, whoſe name was Monſon, inſtead of ſeeking a paſſage to China between the northern countries, had directed his courſe to the pole, and had approached it within two degrees, where there was an open ſea, without any ice." Here he thinks that Mr Buffon has miſtaken Johnſon for Monſon.—9. A map of the northern hemiſphere, publiſhed at Berlin (under the direction of the Academy of Sciences and Belles Lettres), places a ſhip at the pole, as having arrived there according to the Dutch accounts.—10. Moxon, hydrographer to Charles II. gives an account of a Dutch ſhip having been two degrees beyond the pole, which was much relied on by Wood. This veſſel found the weather as warm there as at Amſterdam.

Beſides theſe, there are a great number of other teſtimonies of ſhips which have reached the lat. of 81, 82, 83, 84 (A), &c.; from all which our author concludes, that if the voyage is attempted at a proper time of the year, there would not be any great difficulty of reaching the pole. Thoſe vaſt pieces of ice which commonly obſtruct the navigators, he thinks, proceed from the mouths of the great Aſiatic rivers which run northward into the frozen ocean, and are driven eaſtward and weſtward by the currents. But though we ſhould ſuppoſe them to come directly from the pole, ſtill our author thinks that this affords an undeniable proof that the pole itſelf is free from ice; becauſe, when the pieces leave it, and come to the ſouthward, it is impoſſible that they can at the ſame time accumulate at the pole.

14 Why we cannot ſuppoſe the ſea all round the pole to be frozen.

The extreme cold of the winter air on the continents of Aſia and America has afforded room for ſuſpicion, that the pole itſelf, and for ſeveral degrees to the ſouthward of it, the ſea muſt be frozen to a vaſt depth in one ſolid cake of ice; but this Mr Barrington refutes from ſeveral conſiderations. In the firſt place, he ſays, that on ſuch a ſuppoſition, by the continual intenſity of the cold, and the accumulation of ſnow and frozen vapour, this cake of ice muſt have been increaſing in thickneſs ſince the creation, or at leaſt ſince the deluge; ſo that now it muſt be equal in height to the higheſt mountains in the world, and be viſible at a great diſtance. Beſides, the pieces broken off from the ſides of ſuch an immenſe mountain muſt be much thicker than any ice that is met with in the northern ocean; none of which is above two yards in height above the ſurface of the water, thoſe immenſe pieces called *ice-mountains* being always formed on land.

Again, the ſyſtem of nature is ſo formed, that all parts of the earth are expoſed for the ſame length of time, or nearly ſo, throughout the year to the rays of the ſun. But, by reaſon of the ſpheroidal figure of the terraqueous globe, the poles and polar regions enjoy the ſun ſomewhat longer than others; and hence the Dutch who wintered in Nova Zembla in 1672 ſaw the ſun a fortnight ſooner than they ought to have done by aſtronomical calculations. By reaſon of this flatneſs about the poles, too, the ſun not only ſhines for a greater ſpace of time on theſe inhoſpitable regions, but with leſs obliquity in the ſummer-time, and hence the effect of his rays muſt be the greater. Now Mr Barrington conſiders it is an abſurd ſuppoſition, that this glorious luminary ſhould ſhine for ſix months on a cake of barren ice where there is neither animal nor vegetable. He ſays that the polar ſeas are aſſigned by nature as the habitation of the whales, the largeſt animals in the creation; but if the greateſt part of the polar ſeas are for ever covered with an impenetrable cake of ice, theſe huge animals will be confined within very narrow bounds; for they cannot ſubſiſt without frequently coming to the top of the water to breathe.

15 Quantity of ice formed is not always in proportion to the degree of cold.

Laſtly, the quantity of water frozen by different degrees of cold is by no means directly in proportion to the

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(A) See *M. Bauche's Obſervations on the North or Ice Sea*, where he gives an account of various attempts made to reach the pole, from which he is convinced that the ſea is there open, and that the thing is practicable. M. de Pages, in his *Travels*, Vol. III. informs us, that he wiſhed to take a voyage to the north ſeas, for the purpoſe of bringing under one view the various obſtacles from the ice, which have impeded the reſearches of navigators in thoſe ſeas; and for this purpoſe he was prepared to continue his voyage to as high a latitude as poſſible, and that he might be able to ſay whether any land actually exiſts north from the coaſt of Greenland. He ſailed without any encouragement from his court (France) on the 16th of April 1776 from the Texel, in a Dutch veſſel bound to Spitſbergen. On the 16th of May ſhe was a little way north of 81°, the higheſt latitude ſhe reached.

"Being now (ſays the author) leſs than 180 leagues from the pole, the idea of ſo ſmall a diſtance ſerved effectually to awaken my curioſity. Had I been able to inſpire my fellow-voyagers with ſentiments ſimilar to my own, the winds and currents which at this moment carried us faſt towards the pole, a region hitherto deemed innacceſſible to the eye of mortals, would have been ſaluted with acclamations of joy. This quarter, however, is not the moſt eligible for ſuch an enterprize: here the ſea lying in the vicinity of thoſe banks of ice, ſo frequent a little farther to the weſt, is much too confined. Neverthele ſs, when I conſider the very changeable nature of the ſhoals under whatever form, even in their moſt crowded and compact ſtate; their conſtant changes and concuſſions which break and detach them from one another, and the various expedients that may be employed for freeing the ſhip from confinement, as well as for obviating impending danger—I am far from viewing a voyage to the pole as a chimerical idea."

the intenſity of the cold, but likewiſe to the duration of it. Thus, large bodies of water are never frozen in any temperature of ſhort duration, though ſhallow bodies often are. Our author obſerves, that as much of a given maſs of water was frozen in five hours of a temperature 12° below the freezing point, as was frozen in one hour of the temperature 50° below it; and that long duration of the temperature between 20 and 32 is, with regard to the congelation of water, equivalent to intenſity of cold ſuch as is marked 0 and below 0 in Fahrenheit, but of ſhort duration. See COLD and CONGELATION.

16
Mr Forſter's arguments againſt the poſſibility of reaching the pole,

On the other hand, Mr Forſter, in his Obſervations, takes the contrary ſide of the queſtion with no little vehemence. "I know (ſays he) that M. de Buffon, Lomonoſof, and Crantz, were of opinion, that the ice found in the ocean is formed near the lands only from the freſh water and ice carried down into the ſea by the many rivers in Siberia, Hudſon's Bay, &c.; and therefore, when we fell in with ſuch quantities of ice in December 1772, I expected we ſhould ſoon meet with the land from whence theſe ice maſſes had been detached. But being diſappointed in the diſcovery of this land, though we penetrated beyond the 67° twice, and once beyond 71°, ſouth latitude, and having beſides ſome other doubts concerning the exiſtence of the pretended ſouthern continent, I thought it neceſſary to inquire what reaſons chiefly induced the above authors to form the opinion that the ice floating in the ocean muſt be formed near land, or that an auſtral land is abſolutely requiſite for that purpoſe; and having looked for their arguments, I find they amount chiefly to this: 'That the ice floating in the ocean is all freſh: that ſalt water does not freeze at all; or if it does, it contains briny particles. They infer from thence, that the ice in the ocean cannot be formed in the ſea far from any land, there muſt therefore exiſt auſtral lands; becauſe, in order to form an idea of the original of the great ice-maſſes agreeably to what is obſerved in the northern hemiſphere, they find that the firſt point for fixing the high ice-iſlands is the land; and, ſecondly, that the great quantity of flat ice is brought down the rivers.' I have impartially and carefully conſidered and examined theſe arguments, and compared every circumſtance with what we ſaw in the high ſouthern latitude, and with other known facts; and will here inſert the reſult of all my inquiries on this ſubject.

"Firſt, they obſerve the ice floating in the ocean to yield, by melting, freſh water: which I believe to be true. However, hitherto it has by no means been generally allowed to be freſh: for Crantz ſays expreſsly, that 'the flat pieces (forming what they call the *ice-fields*) are ſalt, becauſe they were congealed from ſea-water.' The ice taken up by us for watering the ſhip was of all kinds, and nevertheleſs we found it conſtantly freſh: Which proves, either that the principle of analogy cannot be applied indiſcriminately in both hemiſpheres; and that one thing may be true in the northern hemiſphere which is quite otherwiſe in the ſouthern, from reaſons not yet known or diſcovered by us; or we muſt think that Crantz and others are miſtaken, who ſuppoſe the ice floating in the ocean to be ſalt.

"The next remark is, That ſalt water does not freeze at all; or if it does, it contains briny particles. M. de Buffon tells us, 'that the ſea between Nova Zembla and Spitzbergen, under the 79° north latitude, does not freeze, as it is there conſiderably broad; and that it is not to be apprehended to find the ſea frozen not even under the pole itſelf; for inded there is no example of having ever found a ſea wholly frozen over, and at a conſiderable diſtance from the ſhores; that the only inſtance of a ſea entirely frozen is that of the Black Sea, which is narrow and not very ſalt, and receives a great many rivers coming from northern regions, and bringing down ice that this ſea therefore ſometimes freezes to ſuch a degree, that its whole ſurface is congealed to a conſiderable thickneſs; and, if the hiſtorians are to be credited, was frozen, in the reign of the emperor Conſtantine Copronymus, 30 ells thick, not including 20 ells of ſnow which was lying on the ice. This fact, continues M. de Buffon, ſeems to be exaggerated: but it is true, however, that it freezes almoſt every winter; whilſt the high ſeas which are 1000 leagues nearer towards the pole do not freeze; which can have no other cauſe than the difference in ſaltneſs, and the little quantity of ice carried out by rivers, if compared to the enormous quantity of ice which the rivers convey into the Black Sea.' M. de Buffon is not miſtaken when he mentions that the Black Sea frequently freezes. Strabo informs us, that the people near the Boſphorus Cimmerius paſs this ſea in carts from Panticapæum to Phanagorea; and that Neoptolemus, a general of Mithridates Eupator, won a battle with his cavalry on the ice on the very ſpot where he gained a naval victory in the ſummer. Marcellinus Comes relates, that under the conſulſhip of Vincentius and Fravita, in the year 401 after Chriſt, the whole ſurface of the Pontus was covered with ice, and that the ice in ſpring was carried through the Propontis, during 30 days, like mountains. Zonaras mentions the ſea between Conſtantinople and Scutari frozen to ſuch a degree in the reign of Conſtantine Copronymus, that even loaded carts paſſed over it. The prince Demetrius Cantemir obſerves, that in the year 1620-1 there happened ſo intenſe a froſt, that the people walked over the ice from Conſtantinople to Iſkodar. All theſe inſtances confirm M. de Buffon's aſſertion. But as this great natural hiſtorian ſays that the Black Sea is the only inſtance of a ſea being entirely frozen (B), I muſt beg leave to diſſent from him; for it is equally well atteſted that the Baltic is ſometimes entirely frozen, according to Caſpar Schutz's account. In the year 1426, the winter was ſo ſevere, that people travelled over the ice acroſs the Baltic from Dantzic to Lubeck; and the ſea was likewiſe paſſable from Denmark to Mecklenburgh: and in the year 1459 the whole Baltic was entirely frozen, ſo that perſons travelled, both on foot and on horſeback, over

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(B) In the year 860 the Mediterranean was covered with ice, ſo that people travelled in carts and horſes acroſs the Ionian Sea to Venice; (*Hermannus Contractus ap. Piſtor. Script.* t. ii. p. 236.) And in 1234 the Mediterranean was again thus frozen, that the Venetian merchants travelled over the ice with their merchandiſe to what place they choſe; *Matth. Paris*, p. 78.

over ice from Denmark to the Vendick Hans-towns, called *Lubeck*, *Wiſmar*, *Roſtock*, and *Stralſund*, which had never happened before; people likewiſe travelled acroſs the Baltic over ice from Reval in Eſtland to Denmark and to Sweden, and back again, without the leaſt danger (c). But according to Sæmund Frode, even the great German Ocean between Denmark and Norway was frozen in the year 1048, ſo that the wolves frequently ran over the ice from one country to the other. The great northern ocean is likewiſe moſt certainly ſometimes frozen to a great diſtance from any land: for Muller relates, that in the year 1715 a Coſſack called *Markoff*, with ſome other perſons, was ſent by the Ruſſian government to explore the north ſea; but finding it next to impoſſible to make any progreſs during ſummer on account of the vaſt quantities of ice commonly filling this ocean, he at laſt determined to try the experiment during winter. He therefore took ſeveral ſledges drawn according to the cuſtom of the country by dogs, which commonly go about 80 or 100 verſts per day, 105 of which make a degree; and on March the 15th, old ſtyle, with this caravan of nine perſons, he left the ſhores of Siberia at the mouth of the river Yana, under the 71° of north latitude, and proceeded for ſeven days together northward, ſo that he had reached at leaſt the 77° or 78° north latitude, when he was ſtopped by the ice, which there began to appear in the ſhape of prodigious mountains. He climbed up to the top of ſome of theſe ice-mountains: but ſeeing from thence no land, nor any thing except ice as far as the eye could reach, and having beſides no more food for his dogs left, he thought it very neceſſary to return; which he with great difficulty performed, on April the 3d, as ſeveral of the dogs, which had periſhed for want, were employed to ſupport thoſe that remained alive. Theſe facts, I believe, will convince the unprejudiced reader, that there are other ſeas beſides the Black Sea which really do freeze in winter, and that the ice carried down the rivers could not at leaſt freeze the German Ocean between Norway and Denmark, becauſe the rivers there are ſo ſmall, and bear a very inconſiderable proportion to the immenſe ocean, which, according to experiments made by Mr Wilke, is very ſalt, though near the land, in the Swediſh harbour of Landſcrona.

"Now, if ſix or ſeven degrees of latitude, containing from 360 to 420 ſea-miles, are not to be reckoned a great diſtance from the land, I do not know in what manner to argue, becauſe no diſtance whatſoever will be reckoned far from any land. Nay, if the Coſſack Markoff, being mounted on one of the higheſt ice-mountains, may be allowed to ſee at leaſt to the diſtance of 20 leagues, the extent alluded to above muſt then be increaſed to 480 Engliſh ſea-miles; which certainly is very conſiderable, and makes it more than probable that the ocean is frozen in winter, in high northern latitudes, even as far as the pole. Beſides, it invalidates the argument which theſe gentlemen wiſh to infer from thence *that the ocean does not freeze in high latitudes, eſpecially where there is a conſiderable broad ſea*; for we have ſhown inſtances to the contrary.

"But M. de Buffon ſpeaks of ice carried down the rivers into the northern ocean, and forming there theſe immenſe quantities of ice. 'And in caſe, ſaye he, we would ſuppoſe, againſt all probability, that at the pole it could be ſo cold as to congeal the ſurface of the ſea, it would remain equally incomprehenſible how theſe enormous floating ice-maſſes could be formed if they had not land for a point to fix on, and from whence they are ſevered by the heat of the ſun. The two ſhips which the India Company ſent in 1739 upon the diſcovery of the auſtral lands, found ice in 47° or 48° ſouth latitude, but at no great diſtance from land; which they diſcovered, without being able to approach it. This ice, therefore, muſt have come from the interior parts of the lands near the ſouth pole; and we muſt conjecture, that it follows the courſe of ſeveral large rivers, waſhing theſe unknown lands, in the ſame manner as the rivers Oby, the Yeniſea, and the other great rivers which fall into the northern ſea, carry the ice-maſſes, which ſtop up the ſtraits of Waigats for the greater part of the year, and render the Tartarian ſea inacceſſible upon this courſe.' Before we can allow the analogy between the rivers Oby, Yeniſea, and the reſt which fall into the northern ocean, and thoſe coming from the interior parts of the auſtral lands, let us compare the ſituation of both countries, ſuppoſing the auſtral lands really to exiſt. The Oby, Yeniſea, and the reſt of the Siberian rivers, falling down into the northern ocean, have their ſources in 48° and 50° north latitude, where the climate is mild and capable of producing corn of all kinds. All the rivers of this great continent increaſing, theſe great rivers have likewiſe their ſources in mild and temperate climates, and the main direction of their courſe is from ſouth to north; and the coaſt of the northern ocean, not reckoning its ſinuoſities, runs in general weſt and eaſt. The ſmall rivers which are formed in high latitudes have, properly ſpeaking, no ſources, no ſprings, but carry off only the waters generated by the melting of ſnow in ſpring, and by the fall of rain in the ſhort ſummer, and are for the greateſt part dry in autumn. And the reaſon of this phenomenon is obvious, after conſidering the conſtitution of the earth in thoſe high northern climates. At Yakutſk, in about 62° north latitude, the ſoil is eternally frozen, even in the height of ſummer, at the depth of three feet from the furnace. In the years 1685 and 1686, an attempt was made to dig a well; and a man, by great and indefatigable labour, continued during two ſummer-ſeaſons, and ſucceeded ſo far in this laborious taſk, that he at laſt reached the depth of 91 feet; but the whole earth at this depth was frozen, and he met with no water; which forced him to deſiſt from ſo fruitleſs an attempt. And it is eaſy to infer from hence how impoſſible it is that ſprings ſhould be formed in the womb of an eternally frozen ſoil.

(c) In 1296 the Baltic was frozen from Gothland to Sweden. (*Incerti auctoris Annales Denor. in Weſtphalii monument. Cimbr.* t. i. p. 1392.

In 1306 the Baltic was, during fourteen weeks, covered with ice between all the Daniſh and Swediſh iſlands. (*Ludwig. reliquiæ, MSS.* t. ix. p. 170.)

In 1323 there was a road for foot-paſſengers and horſemen over the ice on the Baltic during ſix weeks. (*id. ibid.*)

In 1349, people walking over the ice from Stralſund to Denmark. (*Incerti auct. cit. ap. Ludwig.* t. ix. p. 181.)

In 1408 the whole ſea between Gothland and Oeland, and likewiſe between Roſtock and Gezoer, was frozen. (*id. ibid.*)

In 1423 the ice bore riding from Pruſſia to Lubec. (*Crantzii Vandal.* l. x. c. 40.) The whole ſea was covered with ice from Mecklenburg to Denmark. (*Incert. auct. ap. Ludwig.* t. ix. p. 125.)

In 1461 (ſays *Nichol. Marſchallus in Annal. Herul. ap. Weſtphal.* t. i. p. 261.) Tanta erat hyems, ut concreto gelu oceano plauſtris millia paſſuum ſupra CCC merces ad ultimam Thylen (*Iceland*) et Orcades veherentur *e Germania* tota pene bruma.

In 1545 the ſea between Roſtock and Denmark, and likewiſe between Fionia and Sealand, was thus frozen, that the people travelled over the ice on foot, with ſledges to which horſes and oxen were put. (*Anonym. ap. Ludwig.* t. ix. p. 176.)

In 1294 the Cattegat or ſea between Norway and Denmark was frozen; that from Oxſlo in Norway, they could travel on it to Jutland, (*Strelow Chron. Jutbiland*, p. 148.)

17 Of the freezing of ſalt-water.

“The argument, therefore, is now reduced to this, *That ſalt water does not freeze at all; or, if it does, the ice contains briny particles.* But we have already produced numberleſs inſtances, that the ſea does freeze; nay, Crantz allows, *that the flat pieces of ice are ſalt, becauſe they were congealed from ſea-water.* We beg leave to add a few deciſive facts relative to the freezing of the ſea. Barentz obſerves in the year 1596, September the 16th, the ſea froze two fingers thick, and next night the ice was as thick again. This happened in the midſt of September; what effect then muſt the intenſe froſt of a night in January not produce? When Captain James wintered in Carleton's Iſle, the ſea froze in the middle of December 1631. It remains, therefore, only to examine, whether the ice formed in the ſea muſt neceſſarily contain briny particles. And here I find myſelf in a very diſagreeable dilemma; for during the intenſe froſt of the winter in 1776, two ſets of experiments were made on the freezing of ſea-water, and publiſhed, contradicting one another almoſt in every material point. The one by Mr Edward Nairne F. R. S. an ingenious and accurate obſerver; the other by Dr Higgins, who reads lectures on chemiſtry and natural philoſophy, and conſequently muſt be ſuppoſed to be well acquainted with the ſubject. I will therefore ſtill venture to conſider the queſtion as undecided by theſe experiments, and content myſelf with making a few obſervations on them: but previouſly I beg leave to make this general remark, that thoſe who are well acquainted with mechanics, chemiſtry, natural philoſophy, and the various arts which require a nice obſervation of minute circumſtances, need not be informed, that an experiment or machine ſucceeds often very well when made upon a ſmaller ſcale, but will not anſwer if undertaken at large; and *vice verſa*, machines and experiments executed upon a ſmall ſcale will not produce the effect which they certainly have when made in a more enlarged manner. A few years ago an experiment made on the dyeing of ſcarlet, did not ſucceed when undertaken on a ſmall ſcale, whereas it produced the deſired effect when tried at a dyer's houſe with the large apparatus; and it evidently confirms the above aſſertion, which I think I have a right to apply to the freezing of ſalt-water. It is therefore probable, that the ice formed in the ocean at large, in a higher latitude, and in a more intenſe degree of cold, whereof we have no idea here, may become ſolid, and free from any briny particles, though a few experiments made by Dr Higgins, in his houſe, on the freezing of ſalt-water, produced only a looſe ſpongy ice filled with briny particles.

18 Reſult of Mr Nairn's experiments on this ſubject.

“The ice formed of ſea-water by Mr Nairne was very hard, 3½ inches long, and 2 inches in diameter: it follows from thence, that the waſhing the outſide of this ice in freſh water, could not affect the inſide of a hard piece of ice. This ice when melted yielded freſh water, which was ſpecifically lighter than water which was a mixture of rain and ſnow-water, and next in lightneſs to diſtilled water. Had the ice thus obtained not been freſh, the reſiduum of the ſea-water, after this ice had been taken out, could not have been ſpecifically heavier than ſea-water, which, however, was the caſe in Mr Nairne's experiment. It ſeems, therefore, in my opinion, evident from hence, that ſalt-water does freeze, and has no other briny particles than what adhere to its outſide. All this perfectly agrees with the curious fact related by Mr Adanſon (D), who had brought to France two bottles of ſea-water, taken up in different parts of the ocean, in order to examine it, and to compare its ſaltneſs, when more at leiſure; but both the bottles containing the ſalt-water were burſt by being frozen, and the water produced from melting the ice proved perfectly freſh. This fact is ſo fairly ſtated, and ſo very natural, that I cannot conceive it is neceſſary to ſuppoſe, without the leaſt foundation for it, *that the bottles were changed, or that Mr Adanſon does not mention the circumſtance by which the ſea-water was thus altered upon its being diſſolved:* for as he expreſsly obſerves the bottles to have been burſt, it is obvious that the concentrated briny parts ran out, and were entirely drained from the ice, which was formed of the freſh water only.

“The ice formed by Dr Higgins from ſea-water, *conſiſted of thin laminæ, adhering to each other weakly.* Dr Higgins took out the frozen ice from the veſſels wherein he expoſed the ſea-water, and continued to do ſo till the remaining concentrated ſea-water began to form cryſtals of ſea-ſalt. Both theſe experiments, therefore, by no means prove what the Doctor intended to infer from thence; for it was wrong to take out ſuch ice, which only *conſiſted of thin laminæ, adhering to each other weakly.* Had he waited with patience, he would have obtained a hard ice as well as Mr Nairne, which by a more perfect congelation, would have excluded the

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(D) Second Supplement to the Probability of reaching the North Pole, p. 119.

the briny particles intercepted between the *thin laminæ, adhering to each other weakly;* and would have connected the laminæ, by others formed by freſh water. The Doctor found afterwards, it is true, thicker and ſomewhat more ſolid ice: but the ſea-water had already been ſo much concentrated by repeated congelations, that it is no wonder the ice formed in it became at laſt brackiſh: it ſhould ſeem, then, that no concluſive arguments can be drawn from theſe experiments.

“There are two other objections againſt the formation of the ice in the great ocean. The *firſt* is taken from the immenſe bulk and ſize of the ice maſſes formed in the ocean, which is *the deepeſt maſs of water we know of*. But it has been experimentally proved, that in the midſt of ſummer, in the latitudes of 55°, 55° 26′, and 64° ſouth, at 100 fathoms depth, the thermometer ſtood at 34°, 34°½ and 32°; and that in all inſtances, the difference between the temperature at top and 100 fathoms depth never exceeded four degrees of Fahrenheit's thermometer, or that the temperature of the air did not differ five degrees from that of the ocean at 100 fathom deep. If we now add to this, that beyond the 71° ſouth the temperature of the air and ocean muſt be ſtill colder, and that the rigours of an antarctic winter are certainly more than ſufficient to cool the ocean to 28°½, which is requiſite for congealing the aqueous particles in it; if we moreover conſider, that theſe ſevere froſts are continued during ſix or eight months of the year, we may eaſily conceive that there is time enough to congeal large and extenſive maſſes of ice. But it is likewiſe certain, that there is more than one way by which thoſe immenſe ice maſſes are formed. We ſuppoſe very juſtly, that the ocean does freeze, having produced ſo many inſtances of it; we allow likewiſe, that the ice thus formed in a calm, perhaps does not exceed three or four yards in thickneſs; a ſtorm probably often breaks ſuch an ice-field, which Crantz allows to be 200 leagues one way and 80 the other; the preſſure of the broken fragments againſt one another frequently ſets one upon the other piece, and they freeze in that manner together; ſeveral ſuch double pieces, thrown by another preſſure upon one another, form at laſt large maſſes of miles extent, and of 20, 40, 60, and more fathoms thickneſs, or of a great bulk or height. Martens, in his deſcription of Spitzbergen, remarks, that the pieces of ice cauſe ſo great a noiſe by their ſhock, that the navigators in thoſe regions can only with difficulty hear the words of thoſe that ſpeak; and as the ice-pieces are thrown one upon another, ice-mountains are formed by it. And I obſerved very frequently, in the years 1772 and 1773, when we were among the ice, maſſes which had the moſt evident marks of ſuch a formation, being compoſed of ſtrata of ſome feet in thickneſs. This is in ſome meaſure confirmed by the ſtate in which the Coſſack Markoff found the ice at the diſtance of 420 miles north from the Siberian coaſts. The high maſſes were not found formed, as is ſuſpected in the *Second ſupplement to the probability of reaching the north pole*, p. 143-145, near the land, under the high cliffs, but far out at ſea; and when theſe ice mountains were climbed by Markoff, nothing but ice, and no veſtiges of land, appeared as far as the eye could reach. The high climates near the poles are likewiſe ſubject to heavy falls of ſnow, of ſeveral yards in thickneſs, which grow more and more compact, and by thaws and rain are formed into ſolid ice, which increaſe the ſtupendous ſize of the floating ice mountains.

“The *ſecond* objection againſt the freezing of the ocean into ſuch ice as is found floating in it, is taken from the *opacity* of ice formed in ſalt water; becauſe the largeſt maſſes are commonly tranſparent like cryſtal, with a fine blue tint, cauſed by the reflection of the ſea. This argument is very ſpecious, and might be deemed unanſwerable by thoſe who are not uſed to cold winters and their effects. But whoſoever has ſpent ſeveral winters in countries which are ſubject to intenſe froſts, will find nothing extraordinary or difficult in this argument: for it is a well-known fact in cold countries, that the ice which covers their lakes and rivers is often opaque, eſpecially when the froſt ſets in, accompanied by a fall of ſnow; for, in thoſe inſtances, the ice looks, before it hardens, like a dough or paſte, and when congealed it is opaque and white; however, in ſpring, a rain and the thaw, followed by froſty nights, change the opacity and colour of the ice, and make it quite tranſparent and colourleſs like a cryſtal: but, in caſe the thaw continues, and it ceaſes entirely to freeze, the ſame tranſparent ice becomes ſoft and porous, and turns again entirely opaque. This I believe may be applicable to the ice ſeen by us in the ocean. The field-ice was commonly opaque; ſome of the large maſſes, probably drenched by rain, and frozen again, were tranſparent and pellucid; but the ſmall fragments of looſe ice, formed by the decay of the large maſſes, and ſoaked by long-continued rains, we found to be porous, ſoft, and opaque.

“It is likewiſe urged as an argument againſt the formation of ice in the ocean, that it always requires land, in order to have a point upon which it may be fixed. Firſt, I obſerve, that in Mr Nairne's experiments, the ice was generated on the ſurface, and was ſeen ſhooting cryſtals downwards: which evidently evinces, in my opinion, that ice is there formed or generated where the intenſeſt cold is; as the air ſooner cools the ſurface than the depth of the ocean, the ice ſhoots naturally downwards, and cools the ocean more and more, by which it is prepared for further congelation. I ſuppoſe, however, that this happens always during calms, which are not uncommon in high latitudes, as we experienced in the late expedition. Nor does land ſeem abſolutely neceſſary in order to fix the ice; for this may be done with as much eaſe and propriety to the large ice mountains which remain undiſſolved floating in the ocean in high latitudes; or it may, perhaps, not be improper to ſuppoſe, that the whole polar region, from 80° and upwards, in the ſouthern hemiſphere, remains a ſolid ice for ſeveral years together, to which yearly a new circle of ice is added, and of which, however, part is broken off by the winds and the return of the mild ſeaſon. Wherever the ice floats in large maſſes, and ſometimes in compact bodies formed of an infinite number of ſmall pieces, there it is by no means difficult to freeze the whole into one piece; for amongſt the ice the wind has not a power of raiſing high and great waves. This circumſtance was not entirely unknown to the ancients; and it is probable they acquired this information from the natives of ancient Gaul, and from the Britons and other northern nations, who ſometimes undertook long voyages. The northern ocean was called by the ancients the *frozen*, the *dead*, the *lazy*, and *immoveable ſea:* ſometimes they gave it the name *mare cronium*, the concrete ſea, and *morimaruſa*, the dead ſea. And, what is very remarkable, in all the northern cold countries the froſt ſometimes is ſo intenſe, that all the waters become ſuddenly coagulated into a kind of paſte or dough, and thus at once congeal."

19 Obſervations on Mr Forſter's reaſoning.

On this reaſoning of Mr Forſter's, however, we muſt obſerve, that it cannot poſſibly invalidate any fact which Mr Barrington has advanced. The beſt concerted and moſt plauſible theory in the world muſt yield to experience; for this is in fact what muſt judge all theories. Now, from what we have already related, it is demonſtrated, that in the ſpace between the mouths or the rivers Piaſida and Chatanga more ice muſt be formed, and more intenſe colds generated, than in any other part of the world; conſequently, for a conſiderable ſpace, both on the eaſt and weſt ſide of that, the ſea muſt be more full of ice than any where elſe. Now, between theſe two rivers there is the promontory of Taimura, which runs out to the latitude of 78°, or near it, and which of neceſſity muſt obſtruct the diſperſion of the ice; and that it actually does ſo is in ſome degree probable; becauſe in one of the Ruſſian voyages abovementioned the eaſtern mouth of the Lena was quite free, when the weſtern ones were entirely choaked up with ice. Now the mouth of the Yana lies ſeveral degrees to the eaſtward of the Lena: conſequently, when the ice comes eaſtward from the cape of Taimura, it muſt neceſſarily fill all that ſea to the latitude of 78° and upwards; but the Coſſack Markoff, if he proceeded directly north, could not be farther than the promontory of Taimura, and conſequently ſtill enveloped among the ice. Beſides, we are certain, that the ſea in 78° is not at all frozen into a ſolid cake in ſome places, ſince Lord Mulgrave, in 1773, reached 81°. Mr Forſter's argument, therefore, either proves nothing, or it proves too much. If it proves, that about the middle of the eaſtern continent the cold is ſo intenſe that a ſufficient quantity of ice is formed to obſtruct the navigation for ſeveral hundred miles round, this proves nothing; becauſe we knew before that this muſt be the caſe: But if it proves, that the ſea muſt be unnavigable by reaſon of ice all round the globe at 78° N. L. this is too much; becauſe we certainly know, that in 1773 Lord Mulgrave reached the latitude of 81°. However, though it ſhould be allowed that the ſea is quite clear all the way to the pole, it muſt be a very great uncertainty whether any ſhip could by that way reach the Eaſt Indies; becauſe we know that it muſt ſail down between the continents of Aſia and America, through that ſtrait whoſe mouth muſt often be blocked up with ice driving eaſtward along the continent of Aſia.

The ſouth pole is ſtill more inacceſſible than the north pole; for the ice is found in much lower ſouthern than northern latitudes. Upon this ſubject M. Pages ſpeaks thus: "Having in former voyages (ſays he) viſited many parts of the terraqueous globe in different latitudes, I had opportunities of acquiring a conſiderable knowledge of climate in the torrid as well as in the temperate diviſions of the earth. In a ſubſequent voyage I made it my buſineſs to be equally well informed reſpecting the reputed inhoſpitable genius of the South Seas; and upon my return from that expedition I entertained not the ſmalleſt doubt that there exiſts a peculiar and perpetual rigour in the ſouthern hemiſphere.' (See his *Travels round the World*, v. iii. tranſlated from the French, and printed at London, 1792, for Murray.) This ſuperior degree of cold has by many been ſuppoſed to proceed from a greater quantity of land about the ſouth than the north pole *; and the notion of a vaſt continent in theſe regions prevailed almoſt univerſally, inſomuch that many have ſought for it, but hitherto in vain. See the articles *Cook's Diſcoveries*, n° 38—49. and n° 68. and 69. *South-Sea*, and *Terra Auſtralis*.

* See America, n° 3—5, and Cook's Diſcoveries, n° 38, &c.

Magnetic Pole. See Magnet, Magnetism, § 4. p. 432. and p. 441. and Variation.

North Pole. See Pole.

Pole-Axe, a ſort of hatchet nearly reſembling a battle-axe, having an handle about 15 inches in length, and being furniſhed with a ſharp point or claw, bending downwards from the back of its head; the blade whereof is formed like that of any other hatchet. It is principally employed in ſea-fights to cut away and deſtroy the rigging of any adverſary who endeavours to board.

Pole-axes are alſo ſaid to have been ſucceſsfully uſed on ſome occaſions in boarding an enemy, whoſe ſides were above thoſe of the boarder. This is executed by detaching ſeveral gangs to enter at different parts of the ſhip's length, at which time the pole-axes are forcibly driven into her ſide, one above another, ſo as to form a ſort of ſcaling-ladders.

Pole Cat. See Mustela.

Pole Star. See Astronomy, n° 3. 17. and 39.

POLEIN, in Engliſh antiquity, is a ſort of ſhoe, ſharp or picked at the point. This faſhion took its riſe in the time of king William Rufus; and the picks were ſo long, that they were tied up to the knees with ſilver or golden chains. They were forbidden by ſtat. an. 4 Edw. IV. cap. *Tunc fluxus crinium, tunc luxus veſtium, tunc uſus calceorum cum arcuatis aculeis inventus eſt.* Malmeſb. in Will. ii.

POLEMARCHUS was a magiſtrate at Athens, who had under his care all the ſtrangers and ſojourners in the city, over whom he had the ſame authority that the archon had over the citizens. It was his duty to offer a ſolemn ſacrifice to Enyalus (ſaid to be the ſame with Mars, though others will have it that he was only one of his attendants), and another to Diana, ſurnamed Αγροτερα, in honour of the famous patriot Harmodius. It was alſo his buſineſs to take care that the children of thoſe that had loſt their lives in the ſervice of their country ſhould be provided for out of the public treaſury.

Potter's Grecian Antiquities.

POLEMICAL, in matters of literature, an appellation given to books of controverſy, eſpecially thoſe in divinity.

POLEMO, who ſucceeded Zenocrates in the direction of the academy, was an Athenian of diſtinguiſhed birth, and in the earlier part of his life a man of looſe morals. The manner in which he was reclaimed from the purſuit of infamous pleaſures, and brought under the diſcipline of philoſophy, affords a memorable example of the power of eloquence employed in the cauſe of virtue. His hiſtory is thus related by Dr Enfield: "As he was, one morning about the riſing of the ſun, returning home from the revels of the night,

night clad in a looſe robe, crowned with garlands, ſtrongly perfumed, and intoxicated with wine, he paſſed by the ſchool of Xenocrates, and ſaw him ſurrounded with his diſciples. Unable to reſiſt ſo fortunate an opportunity of indulging his ſportive humour, he ruſhed without ceremony into the ſchool, and took his place among the philoſophers. The whole aſſembly was aſtoniſhed at this rude and indecent intruſion, and all but Xenocrates diſcovered ſigns of reſentment. Xenocrates, however, preſerved the perfect command of his countenance; and with great preſence of mind turned his diſcourſe from the ſubject on which he was treating to the topics of temperance and modeſty, which he recommended with ſuch ſtrength of argument, and energy of language, that Polemo was conſtrained to yield to the force of conviction. Inſtead of turning the philoſopher and his doctrine to ridicule, as he at firſt intended, he became ſenſible of the folly of his former conduct; was heartily aſhamed of the contemptible figure which he had made in ſo reſpectable an aſſembly; took his garland from his head; concealed his naked arm under his cloak; aſſumed a ſedate and thoughtful aſpect; and, in ſhort, reſolved from that hour to relinquiſh his licentious pleaſures, and devote himſelf to the purſuit of wiſdom. Thus was this young man, by the powerful energy of truth and eloquence, in an inſtant converted from an infamous libertine to a reſpectable philoſopher. In ſuch a ſudden change of character it is difficult to avoid paſſing from one extreme to another. Polemo, after his reformation, in order to brace up his mind to the tone of rigid virtue, conſtantly practiſed the ſevereſt auſterity and moſt hardy fortitude. From the thirtieth year of his age to his death he drank nothing but water. When he ſuffered violent pain, he ſhowed no external ſign of anguiſh. In order to preſerve his mind undiſturbed by paſſion, he habituated himſelf to ſpeak in an uniform tone of voice, without elevation or depreſſion. The auſterity of his manners was, however, tempered with urbanity and generoſity. He was fond of ſolitude, and paſſed much of his time in a garden near his ſchool. He died, at an advanced age, of a conſumption. Of his tenets little is ſaid by the ancients, becauſe he ſtrictly adhered to the doctrine of Plato."

POLEMONIUM, Greek Valerian, or *Jacob's Ladder*: A genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 29th order, *Campanaceæ*. The corolla is quinquepartite; the ſtamina inſerted into ſcales which cloſe the bottom of the corolla; the ſtigma is trifid: the capſule bilocular ſuperior. There are two ſpecies, of which the moſt remarkable is the cœruleum, with an empalement longer than the flower. It grows naturally in ſome places of England: however, its beauty has obtained it a place in the gardens. There are three varieties; one with a white, another with a blue, and another with a variegated flower; alſo a kind with variegated leaves. They are eaſily propagated by ſeeds; but that kind with variegated leaves is preſerved by parting its roots, becauſe the plants raiſed from ſeeds would be apt to degenerate and become plain.

POLEMOSCOPE, in optics, the ſame with Opera-glass. See Dioptrics, p. 37. col. 1. par. 3.

POLENBURG (Cornelius), an excellent painter of little landſcapes and figures, was born at Utrecht in 1586, and educated under Blomaert, whom he ſoon quitted to travel into Italy; and ſtudied for a long time in Rome and Florence, where he formed a ſtyle entirely new, which, though preferable to the Flemiſh, is unlike any Italian, except in his having adorned his landſcapes with ruins. There is a varniſhed ſmoothneſs and finiſhing in his pictures, that render them always pleaſing, though ſimple and too nearly reſembling one another. The Roman cardinals were charmed with the neatneſs of his works, as was alſo the great duke; but could not retain him. He returned to Utrecht, and pleaſed Rubens, who had ſeveral of his performances. King Charles I. invited him to London, where he generally painted the figures in Steenwyck's perſpectives: but the king could not prevail on him to fix there; for after ſtaying only four years, and being handſomely rewarded by his majeſty for ſeveral pieces which he performed for him, he returned to Utrecht, and died there at the age of 74. His works are very ſcarce and valuable.

POLERON, one of the Banda or nutmeg iſlands in the Eaſt Indies. This was one of thoſe ſpice iſlands which put themſelves under the protection of the Engliſh, and voluntarily acknowledged James I. king of England for their ſovereign; for which reaſon the natives of this and the reſt of the iſlands were murdered or driven thence by the Dutch, together with the Engliſh.

POLESIA, a province of Poland, bounded by Polachio and Proper Lithuania on the north, and by Volhinia on the ſouth. It is one of the palatinates of Lithuania, and is commonly called *Breſcia*, and its capital is of this name. It is full of foreſts and lakes.

POLESINO-de-Rovigo, a province of Italy, in the republic of Venice, lying to the north of the river Po; and bounded on that ſide by the Paduan, on the ſouth by the Ferrareſe, on the Eaſt by Degado, and on the weſt by the Veroneſe. It is 45 miles in length, and 17 in breadth, and is a fertile country. Rovigo is the capital.

POLETÆ were ten magiſtrates of Athens, who, with three that had the management of money allowed for public ſhows, were empowered to let out the tribute-money and other public revenues, and to ſell confiſcated eſtates; all which bargains were ratified by their preſident, or in his name. They were by their office alſo bound to convict ſuch as had not paid the tribute called Μετοικιον, and ſell them in the market by auction. The market where theſe wretches were ſold was called πωλητηριον τȣ μετοικιȣ.

POLIANTHES, the Tuberose: A genus of the monogynia order, belonging to the hexandria claſs of plants; and in the natural method ranking under the 10th order, *Coronariæ*. The corolla is funnel-ſhaped, incurvated, and equal; the filaments are inſerted into the throat of the corolla; in the bottom of which the germen is ſituated. There is but one ſpecies, conſiſting of ſome varieties; all of which being exotics of tender quality, require aid of artificial heat, under ſhelter of frames and glaſſes, &c. to bring them to flower in perfection in cold countries. The polianthes, or tuberoſe, hath an oblong, bulb-like, tuberous, white root; crowned with a few long very narrow leaves; amidſt them an upright, ſtraight, firm ſtem, three or four feet high, terminated by a long ſpike of large white flowers arranged alternately. The varieties are the common tuberoſe, with ſingle flowers,—double-flowered,—dwarf-ſtalked,—variegated-leaved. They all flower here in June, July, and Auguſt: the flowers are funnel or bell ſhaped; garniſh the upper part of the ſtem in a long ſpike, conſiſting of from 10 to 20 or more ſeparate in alternate arrangements, the lower flowers opening firſt, which are ſucceeded by thoſe above, in regular order, making in the whole a moſt beautiful appearance, highly enriched with a moſt fragrant odour. The common ſingle-flowered tuberoſe is the ſort the moſt commonly cultivated, as it generally blows the moſt freely, and poſſeſſes the fineſt fragrance. The double-flowered kind alſo highly merits culture, as when it blows fair it makes a ſingularly fine apppearance. The dwarf and the variegated kinds are inferior to the other two, but may be cultivated for variety.

All the varieties being exotics from warm countries, although they are made to flower in great perfection in Britiſh gardens by aſſiſtance of hot-beds, they will not proſper in the open ground, and do not increaſe freely in England; ſo that a ſupply of the roots is imported thither annually from Genoa, and other parts of Italy, by moſt of the eminent nurſery and ſeedſmen, and the Italian warehouſe-keepers; generally arriving in February or March, time enough for the enſuing ſummer's bloom; and are ſold commonly at the rate of twelve or fifteen ſhillings per hundred, being careful always to procure as large roots as poſſible, for on this depends the ſucceſs of having a complete blow. They, requiring artificial heat to blow them in cold countries, are planted in pots, and plunged in a hot-bed, under a deep frame furniſhed with glaſs lights; or placed in a hot-houſe, where they may be blowed to great perfection with little trouble. The principal ſeaſon for planting them is March and April: obſerving, however, that in order to continue a long ſucceſſion of the bloom, it is proper to make two or three different plantings, at about a month interval; one in March, another in April, and a third the beginning of May, whereby the blow may be continued from June until September; obſerving, as above-mentioned, they may be flowered either by aid of a common dung or bark hot-bed, or in a hot-houſe.

With reſpect to the propagation of theſe plants, it is principally by offſets of the roots. The blowing roots that are brought annually from abroad for ſale are often furniſhed with offſets, which ought to be ſeparated previous to planting. Thoſe alſo that are planted in the gardens frequently furniſh offſets fit for ſeparation in autumn when the leaves decay; they muſt then be preſerved in ſand all winter in a dry ſheltered place; and in the beginning of March, plant them either in a bed of light dry earth in the full ground; or, to forward them as much as poſſible, allow them a moderate hot-bed; and in either method indulge them with a ſhelter in cold weather, either of a frame and lights, or arched with hoops and occaſionally matted; but let them enjoy the full air in all mild weather, giving alſo plenty of water in dry weather during the ſeaſon of their growth in ſpring and ſummer. Thus let them grow till their leaves again decay in autumn: then take them up, clean them from earth, and lay them in ſand till ſpring; at which time ſuch roots as are large enough to blow may be planted and managed as already directed, and the ſmaller roots planted again in a nurſery-bed, to have another year's growth; afterwards plant them for flowering. The Egyptians put the flowers of tuberoſe into ſweet oil; and by this means give it a moſt excellent flavour, ſcarce inferior to oil of jaſmine.

POLICANDRO, a ſmall iſland in the Archipelago, ſeated between Milo and Morgo. It has no harbour, but has a town about three miles from the ſhore near a huge rock. It is a ragged ſtony iſland, but yields as much corn as is ſufficient for the inhabitants, who conſiſt of about 120 Greek families, all Chriſtians. The only commodity is cotton; of which they make napkins, a dozen of which are ſold for a crown. E. Long. 35. 25. N. Lat. 36. 36.

POLICASTRO, an epiſcopal town of Italy, in the kingdom of Naples, and in the Hither Principato; but now almoſt in ruins, for which reaſon the biſhop reſides in another town. E. Long. 15. 46. N. Lat. 40. 26.

POLICY, or POLITY, in matters of government. See POLITY.

POLICY of Inſurance, or *Aſſurance*, of ſhips, is a contract or convention, whereby a perſon takes upon himſelf the riſks of a ſea-voyage; obliging himſelf to make good the loſſes and damages that may befal the veſſel, its equipage, tackle, victualling, lading, &c. either from tempeſts, ſhipwrecks, pirates, fire, war, repriſals, in part or in whole; in conſideration of a certain ſum of ſeven, eight, or ten *per cent.* more or leſs according to the riſk run; which ſum is paid down to the aſſurer by the aſſuree upon his ſigning the policy. See INSURANCE.

POLIDORO DA CARAVAGGIO, an eminent painter, born at Caravaggio in the Milaneſe in 1492. He went young to Rome, where he worked as a labourer in preparing ſtucco for the painters; and was ſo animated by ſeeing them at work in the Vatican, that he ſolicited ſome of them to teach him the rules of deſigning. He attached himſelf particularly to Maturino, a young Florentine; and a ſimilarity in talents and taſte producing a diſintereſted affection, they aſſociated like brothers, laboured together, and lived on one common purſe, until the death of Maturino. He underſtood and practiſed the chiaro-ſcuro in a degree ſuperior to any in the Roman ſchool; and finiſhed an incredible number of pictures both in freſco and in oil, few of the public buildings at Rome being without ſome of his paintings. Being obliged to fly from Rome when it was ſtormed and pillaged, he retired to Meſſina, where he obtained a large ſum of money with great reputation, by painting the triumphal arches for the reception of Charles V. after his victory at Tunis: and when he was preparing to return to Rome, he was murdered, for the ſake of his riches, by his Sicilian valet with other aſſaſſins, in the year 1543.

POLIFOLIA. See ANDROMEDA.

POLIGNAC (Melchier de), an excellent French genius and a cardinal, was born of an ancient and noble family at Puy, the capital of Velay, in 1662. He was ſent by Louis XIV. ambaſſador extraordinary to Poland, where, on the death of Sobieſki, he formed a project of procuring the election of the prince of Conti. But failing, he returned home under ſome diſgrace; but when reſtored to favour, he was ſent to Rome as auditor of the Rota. He was plenipotentiary during the congreſs at Utrecht, at which time Clement I. created him a cardinal; and upon the acceſſion of Louis XV. he was appointed to reſide at Rome as miniſter of

France. He remained there till the year 1732, and died in the year 1741. He left behind him a MS. poem entitled *Anti-Lucretius, ſeu De Deo et Natura;* the plan of which he is ſaid to have formed in Holland in a converſation with Mr Bayle. This celebrated poem was firſt publiſhed in the year 1749, and has ſince been ſeveral times printed in other countries beſides France. He had been received into the French Academy in 1704, into the Academy of Sciences in 1715, into that of the Belles Lettres in 1717: and he would have been an ornament to any ſociety, having all the accompliſhments of a man of parts and learning.

POLISHER, or Burnisher, among mechanics, an inſtrument for poliſhing and burniſhing things proper to take a poliſh. The gilders uſe an iron-poliſher to prepare their metals before gilding, and the bloodſtone to give them the bright poliſh after gilding.

The poliſhers, among cutlers, are a kind of wooden wheels made of walnut-tree, about an inch thick, and of a diameter at pleaſure, which are turned round by a great wheel; upon theſe they ſmooth and poliſh their work with emery and putty.

The poliſhers for glaſs conſiſt of two pieces of wood; the one flat, covered with old hat; the other long and half-round, faſtened on the former, whoſe edge it exceeds on both ſides by ſome inches, which ſerves the workmen to take hold of, and to work backwards and forwards by.

The poliſhers uſed by ſpectacle-makers are pieces of wood a foot long, ſeven or eight inches broad, and an inch and a half thick, covered with old beaver hat, whereon they poliſh the ſhell and horn frames their ſpectacle-glaſſes are to be ſet in.

POLISHING, in general, the operation of giving a gloſs or luſtre to certain ſubſtances, as metals, glaſs, marble, &c.

The operation of poliſhing optic-glaſſes, after being properly ground, is one of the moſt difficult points of the whole proceſs. See Telescope.

POLITENESS means elegance of manners or good breeding: Lord Cheſterfield calls it the art of pleaſing. It has alſo been called an artificial good nature; and indeed good nature is the foundation of true politeneſs; without which art will make but a very indifferent figure, and will generally defeat its own ends. "Where compliance and aſſent, caution and candour, ſays an elegant eſſayiſt*, ariſe from a natural tenderneſs of diſpoſition and ſoftneſs of nature, as they ſometimes do, they are almoſt amiable and certainly excuſable; but as the effects of artifice, they muſt be deſpiſed. The perſons who poſſeſs them are, indeed, often themſelves dupes of their own deceit, when they imagine others are deluded by it. For exceſſive art always betrays itſelf; and many, who do not openly take notice of the deceiver, from motives of delicacy and tenderneſs for his character, ſecretly deride and warmly reſent his ineffectual ſubtilty."

"True politeneſs (ſays another author†) is that continual attention which humanity inſpires us with, both to pleaſe others, and to avoid giving them offence. The ſurly plain-dealer exclaims loudly againſt this virtue, and prefers his own ſhocking bluntneſs and Gothic freedom. The courtier and fawning flatterer, on the contrary, ſubſtitute in its place inſipid compliments, cringings, and a jargon of unmeaning ſentences. The one blames politeneſs, becauſe he takes it for a vice; and the other is the occaſion of this, becauſe that which he practiſes is really ſo."

Both theſe characters act from motives equally abſurd, though not equally criminal. The conduct of the artful flatterer is guided by ſelf-love, while that of the plain-dealer is the effect of ignorance; for nothing is more certain, than that the deſire of pleaſing is founded on the mutual wants and the mutual wiſhes of mankind; on the pleaſure which we wiſh to derive from ſociety, and the character which we wiſh to acquire. Men having diſcovered that it was neceſſary and agreeable to unite for their common intereſts, they have made laws to repreſs the wicked, they have ſettled the duties of ſocial life, and connected the idea of reſpectability with the practice of thoſe duties; and after having preſcribed the regulations neceſſary to their common ſafety, they have endeavoured to render their commerce with one another agreeable, by eſtabliſhing the rules of politeneſs and good breeding. Indeed, as an elegant author already quoted remarks, the philoſopher who, in the auſterity of his virtue, ſhould condemn the art of pleaſing as unworthy cultivation, would deſerve little attention from mankind, and might be diſmiſſed to his ſolitary tub, like his brother Diogenes. It is the dictate of humanity, that we ſhould endeavour to render ourſelves agreeable to thoſe in whoſe company we are deſtined to travel in the journey of life. It is our intereſt, it is the ſource of perpetual ſatisfaction; it is one of our moſt important duties as men, and particularly required in the profeſſor of Chriſtianity."

It is needleſs to particularize the motives which have induced men to practiſe the agreeable virtues; for, from whatever ſource the deſire of pleaſing proceeds, it has always increaſed in proportion to the general civilization of mankind. In a rude ſtate of ſociety, pleaſure is limited in its ſources and in its operation. When the wants of mankind, and the means of attaining them, are few, perſonal application is neceſſary to gratify them, and it is generally ſufficient; by which means an individual becomes more independent than can poſſibly be the caſe in civilized life, and of courſe leſs diſpoſed to give or receive aſſiſtance. Confined to the ſolitary wiſh of furniſhing means for his own happineſs, he is little intent on the pleaſures of converſation and ſociety. His deſire of communication is equal to the extent of his knowledge. But as ſoon as the natural wants of life are filled up, we find unoccupied time, and we labour hard to make it paſs in an agreeable manner. It is then we perceive the advantage of poſſeſſing a rational nature, and the delights of mutual intercourſe. When we conſider ſociety in that ſtate of perfection which enables a great part of the members of it to purſue at leiſure the pleaſures of converſation, we ſhould expect, both from the eaſe of acquitting ourſelves to the ſatisfaction of our aſſociates, and from the advantages ariſing from this conduct, that the art of pleaſing might be reduced to a few plain and ſimple rules, and that theſe might be derived from a ſlight attention to general manners.

The art of pleaſing, in our intercourſe with mankind, is indeed ſo ſimple, that it requires nothing more than the conſtant deſire to pleaſe in all our words and actions; and the practice of it can neither wound a man's ſelf love, nor be prejudicial to his intereſt in any poſſible ſituation.

* Dr Knox.

† Beauties of Hiſtory.

But though this be certain, it is doubtleſs leſs attended to than in reaſon it ought to be. Each particular man is ſo zealous to promote his own ends or his own pleaſure, as to forget that his neighbour has claims equal to his own; that every man that enters into company gives up for the time a great many of his peculiar rights; and that he then forms part of an aſſociation, met together not for the particular gratification of any one, but for the purpoſe of general ſatisfaction. See BREEDING, CONVERSATION, and *Good MANNERS*.

The qualities eſſential in the art of pleaſing, are *virtue*, *knowledge*, and *manners*. All the virtues which form a good and reſpectable character in a moral ſenſe are eſſential to the art of pleaſing. This muſt be an eſtabliſhed principle, becauſe it depends on the wants and mutual relations of ſociety. In all affairs of common buſineſs, we delight in tranſacting with men in whom we can place confidence, and in whom we find integrity; but truth is ſo naturally pleaſing, and the common affairs of life are ſo interwoven with ſocial intercourſe, that we derive abundantly more ſatisfaction from an honeſt character than from ſpecious manners. "Should you be ſuſpected (ſays Cheſterfield) of injuſtice, malignity, perfidy, lying, &c. all the parts and knowledge of the world will never procure you eſteem, friendſhip, and reſpect."

The firſt of virtues in our commerce with the world, and the chief in giving pleaſure to thoſe with whom we aſſociate, is inviolable ſincerity of heart. We can never be too punctual in the moſt ſcrupulous tenderneſs to our moral character in this reſpect, nor too nicely affected in preſerving our integrity.

The peculiar modes, even of the faſhionable world, which are founded in diſſimulation, and which on this account have induced ſeveral to recommend the practice, would not prevent a man of the higheſt integrity from being acceptable in the very beſt company. Acknowledged ſincerity gives the ſame ornament to character that modeſty does to manners. It would abundantly atone for the want of ridiculous ceremony, or falſe and unmeaning profeſſions; and it would in no reſpect diminiſh the luſtre of a noble air, or the perfection of an elegant addreſs.

If integrity be the foundation of that character which is moſt generally acceptable, or which, in other words, poſſeſſes the power of pleaſing in the higheſt degree, humanity and modeſty are its higheſt ornaments.

The whole art of pleaſing, as far as the virtues are concerned, may be derived from the one or other of theſe ſources. Humanity comprehends the diſplay of every thing amiable to others; modeſty removes or ſuppreſſes every thing offenſive in ourſelves.

This modeſty, however, is not inconſiſtent with firmneſs and dignity of character: it ariſes rather from the knowledge of our imperfection compared with a certain ſtandard, than from conſcious ignorance of what we ought to know. We muſt therefore diſtinguiſh between this modeſty and what the French call *mauvaiſe honte*. The one is the auaffected and unaſſuming principle which leads us to give preference to the merit of others, the other is the aukward ſtruggling of nature over her own infimities. The firſt gives an additional luſtre to every good quality; while ſome people, from feeling the pain and inconveniency of the *mauvaiſe honte*, have ruſhed into the other extreme, and turned impudent, as cowards ſometimes grow deſperate from exceſs of danger. The medium between theſe two extremes marks out the well-bred man; he feels himſelf firm and eaſy in all companies, is modeſt without being baſhful, and ſteady without being impudent.

A man poſſeſſing the amiable virtues is ſtill farther prepared to pleaſe, by having in his own mind a perpetual fund of ſatisfaction and entertainment. He is put to no trouble in concealing thoughts which it would be diſgraceful to avow, and he is not anxious to diſplay virtues which his daily converſation and his conſtant looks render viſible.

The next ingredient in the art of pleaſing, is to poſſeſs a correct and enlightened underſtanding, and a fund of rational knowledge. With virtue and modeſty we muſt be able to entertain and inſtruct thoſe with whom we aſſociate.

The faculty of communicating ideas is peculiar to man, and the pleaſure which he derives from the interchange alone is one of the moſt important of his bleſſings. Mankind are formed with numberleſs wants, and with a mutual power of aſſiſting each other. It is a beautiful and happy part of the ſame perfect plan, that they are likewiſe formed to delight in each other's company, and in the mutual interchange of their thoughts. The different ſpecies of communication, in a highly poliſhed age, are as numerous as the different ranks, employments, and occupations of men; and indeed the knowledge which men wiſh to communicate, takes its tinge from their peculiar profeſſion or occupation.

Thus commercial men delight to talk of their trade, and of the nature of public buſineſs; men of pleaſures, who wiſh merely to vary or quicken their amuſements, are in converſation light, trifling, and inſincere; and the literati delight to dwell on new books, learned men, and important diſcoveries in ſcience or in arts. But as the different claſſes of men will frequently meet together, all parties muſt ſo contrive matters, as to combine the uſeful and agreeable together, ſo as to give the greateſt delight at the time, and the greateſt pleaſure on reflection. An attention to theſe principles would make the man of pleaſure and the man of learning meet together on equal terms, and derive mutual advantage from their different qualifications. With due attention to ſuch ideas, we proceed to mention the kinds of knowledge which are moſt fitted for converſation. Thoſe who wiſh to pleaſe ſhould particularly endeavour to be informed in thoſe points which moſt generally occur. An accurate or extenſive knowledge on learned ſubjects is by no means ſufficient: we muſt alſo have an accurate and extenſive knowledge of the common occurrences of life.

It is the knowledge of mankind, of governments, of hiſtory, of public characters, and of the ſprings which put the great and the little actions of the world in motion, which give real pleaſure and rational inſtruction. The knowledge which we communicate muſt in ſome ſhape be intereſting to thoſe to whom we communicate it; of that nature, that the deſire of receiving it may overbalance every kind of diſguſt, excited too often on the ſcore of envy and ſelf-love, againſt thoſe who happen to poſſeſs ſuperior endowments, and at the ſame time of that importance, as to elevate the thoughts ſomewhat above the actions and the faults of the narrow circle formed in our own immediate neighbourhood.

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bourhood. On this account it is recommended by an author who fully knew mankind, as a maxim of great importance in the art of pleaſing, to be acquainted with the private character of thoſe men who, from their ſtation or their actions, are making a figure in the world. We naturally wiſh to ſee ſuch men in their retired and undiſguiſed moments; and he who can gratify us is highly acceptable. Hiſtory of all kinds, fitly introduced, and occaſionally embelliſhed with pleaſing anecdotes, is a chief part of our entertainment in the intercouſe of life. This is receiving inſtruction, without exciting much envy; it depends on memory, and memory is one of thoſe talents the poſſeſſion of which we leaſt grudge to our neighbour. Our knowledge of hiſtory, at the ſame time, muſt not appear in long and tedious details; but in apt and well choſen alluſions, calculated to illuſtrate the particular ſubject of converſation. But the knowledge moſt neceſſary is that of the human heart. This is acquired by conſtant obſervation on the manners and maxims of the world, connected with that which paſſes in our own minds. This leads us from the common details of conduct, from ſlander and defamation, to the ſources and principles of action, and enables us to enter into what may be called the philoſophy of converſation. We may ſee both the practicability of this kind of diſcourſe, and the nature of it, in the following lines of Horace:

> Sermo oritur, non de villis domibuſve alienis;
> Nec male necne Lepos ſaltet: ſed quod magis ad nos
> Pertinet, & neſcire malum eſt, agitamus: utrumne
> Divitiis homines, an ſint virtute beati?
> Quidve ad amicitias, uſus rectumne, trahat nos?
> Et quæ ſit natura boni, ſummumque quid ejus? &c.

By this means conſtant materials are ſupplied for free, eaſy, and ſpirited communication. The reſtraints which are impoſed on mankind, either from what their own character may ſuffer, or from the apprehenſion of giving offence to others, are entirely taken off, and they have a ſufficient quantity of current coin for all the common purpoſes of life.

In addition to virtue and knowledge, which are the chief ingredients in the art of pleaſing, we have to conſider graceful and eaſy manners. Lord Cheſterfield indeed conſiders theſe as the moſt eſſential and important part; as if the diamond received its whole value from the poliſh. But though he is unqueſtionably miſtaken, there is yet a certain ſweetneſs of manners which is particularly engaging in our commerce with the world. It is that which conſtitutes the character which the French, under the appellation of *l'aimable*, ſo much talk of, and ſo juſtly value. This is not ſo eaſily deſcribed as felt. It is the compound reſult of different things; as complaiſance, a flexibility, but not a ſervility of manners, an air of ſoftneſs in the countenance, geſture, and expreſſion, equally whether you concur or differ with the perſon you converſe with. This is particularly to be ſtudied when we are obliged to refuſe a favour aſked of us, or to ſay what in itſelf cannot be very agreeable to the perſon to whom we ſay it. It is then the neceſſary gilding of a diſagreeable pill. But this, which may be called the *ſuaviter in modo*, would degenerate and ſink into a mean and timid complaiſance and paſſiveneſs, if not ſupported by firmneſs and dignity of character. Hence the Latin ſentence, *ſuaviter in modo, fortiter in re*, becomes an uſeful and important maxim in life.

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Genuine eaſy manners reſult from a conſtant attention to the relations of perſons, things, time, and places. Were we to converſe with one greatly our ſuperior, we are to be as eaſy and unembarraſſed as with our equals; but yet every look, word, and action, ſhould imply, without any kind of ſervile flattery, the greateſt reſpect. In mixed companies, with our equals, greater eaſe and liberty are allowed; but they too have their proper limits. There is a ſocial reſpect neceſſary. Our words, geſtures, and attitudes, have a greater degree of latitude though not an unbounded one. That eaſineſs of carriage and behaviour which is exceedingly engaging, widely differs from negligence and inattention, and by no means implies that one may do whatever he pleaſes; it only means, that one is not to be ſtiff, formal, and embarraſſed, diſconcerted and aſhamed; but it requires great attention to, and a ſcrupulous obſervation of, what the French call *les bienſeances;* a word which implies "decorum, good-breeding, and propriety." Whatever we ought to do, is to be done with eaſe and unconcern; whatever is improper, muſt not be done at all. In mixed companies, alſo, different ages and ſexes are to be differently addreſſed. Although we are to be equally eaſy with all, old age particularly requires to be treated with a degree of deference and regard. It is a good general rule, to accuſtom ourſelves to have a kind feeling to every thing connected with man; and when this is the caſe, we ſhall ſeldom err in the application. Another important point in the *bienſeances* is, not to run our own preſent humour and diſpoſition indiſcriminately againſt every body, but to obſerve and adopt theirs. And if we cannot command one preſent humour and diſpoſition, it is neceſſary to ſingle out thoſe to converſe with who happen to be in the humour the neareſt to our own. Peremptorineſs and deciſion, eſpecially in young people, is contrary to the *bienſeances:* they ſhould ſeldom ſeem to diſſent, and always uſe ſome ſoftening mitigating expreſſion.

There is a *bienſeance* alſo with regard to people of the loweſt degree; a gentleman obſerves it with his footman, and even indeed with the beggar in the ſtreet. He conſiders them as objects of compaſſion, not of inſult; he ſpeaks to neither in a harſh tone, but corrects the one coolly, and refuſes the other with humanity.

The following obſervations perhaps contain the ſum of the art of pleaſing:

1. A fixed and habitual reſolution of endeavouring to pleaſe, is a circumſtance which will ſeldom fail of effect, and its effect will every day become more viſible as this habit increaſes in ſtrength.

2. This reſolution muſt be regulated by a very conſiderable degree of good ſenſe.

3. It is a maxim of almoſt general application, that what pleaſes us in another will alſo pleaſe others in us.

4. A conſtant and habitual attention to the different diſpoſitions of mankind, to their ruling paſſions, and to their peculiar or occaſional humours, is abſolutely neceſſary.

5. A man who would pleaſe, muſt poſſeſs a firm, equal, and ſteady temper. And,

6. An eaſy and graceful manner, as diſtant from baſhfulneſs on the one hand as from impudence on the other,

Politeneſs, Politian.

Political, Political Arithmetic

other. "He who thinks himſelf ſure of pleaſing (ſays Lord Cheſterfield), and he who deſpairs of it, are equally ſure to fail." And he is undoubtedly in the right. The one, by his aſſuming vanity, is inattentive to the means of pleaſing; and the other, from fear, is rendered incapable of employing them.

A variety of excellent rules for acquiring politeneſs, with ſtrictures on particular kinds of impoliteneſs, may be found in the *Spectator*, *Rambler*, *Idler*, *Lounger*, *Mirror*, and other periodical works of that kind; in *Knox's Eſſays*, and among *Swift's Work's*; ſee *Good Manners*. *Cheſterfield's Art of Pleaſing*, and his *Letters*, are alſo worthy of peruſal, provided the reader be on his guard againſt the inſincerity and other vices which thoſe books are calculated to infuſe, and provided he always bears in mind what we have endeavoured to ſhow in this article, that true politeneſs does not conſiſt in ſpecious manners and a diſſimulating addreſs, but that it muſt always be founded on real worth and intrinſic virtue.

POLITIAN (Angelo), was born at Monte Pulciano in Tuſcany in 1454. He learned the Greek tongue, of which he became a complete maſter, under Andronicus of Theſſalonica. He is ſaid to have written verſes both in Greek and Latin when he was not more than 12 years of age. He ſtudied alſo the Platonic philoſophy under Marſilius Finicus, and that of Ariſtotle under Argyropylus. He was one of the moſt learned and polite writers of his time. The firſt work which gained him a reputation was a poem on the tournament of Julian de Medicis. The account he wrote ſome time after of the conſpiracy of the Pazzi's was very much eſteemed. He wrote many other pieces which have merited approbation; and had he lived longer, he would have enriched the republic of letters with many excellent works; but he died at the age of 40 years. His morals anſwered the homelineſs of his face rather than the beauty of his genius; for Paul Jovius informs us, that "he was a man of aukward and perverſe manners, of a countenance by no means open and liberal, a noſe remarkably large, and ſquinting eyes. He was crafty, ſatirical, and full of inward malice; for his conſtant way was, to ſneer and ridicule the productions of other men, and never to allow any criticiſm, however juſt, upon his own."

He was, nevertheleſs, as all acknowledge, a man of moſt conſummate erudition; and not only ſo, but a very polite and elegant writer. Eraſmus, in his *Ciceronianus*, calls him a rare miracle of nature, on account of his excelling in every kind of writing: his words are remarkable: "*Fateor Angelum prorſus angelica fuiſſe mente, rarum naturæ miraculum, ad quodcunque ſcripti genus applicaret animum.*" Some of his poems were ſo much admired, that ſeveral learned men have made it their buſineſs to comment on them. It has been often reported that he ſpoke of the Bible with great contempt; and that, having read it but once, he complained he had never ſpent his time ſo ill. But this is not probable, for it muſt be remembered that he was a prieſt and canon of Florence; and we learn from one of his Epiſtles that he preached a whole Lent. It does not indeed follow hence, that he did not think contemptuouſly of the Bible, becauſe many of his church, eſpecially among the better ſort, have not been very good believers, and he might be one of them: but it is not likely he would ſpeak out ſo freely. "I could (as Bayle ſays) much more eaſily believe the judgment he is ſaid to have made on the Pſalms of David and the Odes of Pindar: he did not deny that there are many good and fine things in the Pſalms; but he pretended that the ſame things appear in Pindar with more brightneſs and ſweetneſs." The two Scaligers have ſpoken highly of Politian: the elder has preferred a conſolatory elegy of his to that which Ovid ſent to Livia upon the death of Druſus, and ſays, he had rather have been the author of it: the younger calls him an excellent poet, but thinks the ſtyle of his epiſtles too elated and declamatory.

His works have been printed at various times, and in various places: his epiſtles have probably been moſt read, becauſe theſe are things which the generality of people are beſt pleaſed with.

POLITICAL, from πολις "a city," ſignifies any thing that relates to policy or civil government.

Political Arithmetic, is the art of reaſoning by figures upon matters relating to government, ſuch as the revenues, number of people, extent and value of land, taxes, trade, &c. in any nation.

Theſe calculations are generally made with a view to aſcertain the comparative ſtrength, proſperity, &c. of any two or more nations. With this view, Sir William Petty, in his *Political Arithmetic*, p. 74, &c. computes the land of Holland and Zealand to be about 1,000,000 acres, and that of France to be 8,000,000; and yet the former is one-third part as rich and ſtrong as the latter. The ſhipping of Europe he computes to be about 2,000,000, of which Britain has 500,000; Holland 900,000; France 100,000; Hamburgh, Denmark, Sweden, and Dantzic 250,000; and Spain, Portugal, Italy, &c. the reſt. The exports of France he computes at L. 5,000,000, of which one fourth came to Britain; of Holland L. 18,000,000, of which L. 300,000, came to Britain. The money raiſed yearly by the king of France was about L. 6,500,000 Sterling; that of all the Dutch provinces L. 3,000,000, of which 2,100,000 was raiſed in Holland and Zealand. The number of people in England he computed to be ſix millions, and their expences, at L. 7 *per annum* a head, L. 42,000,000; the rent of land L. 8,000,000; and the intereſts, &c. of perſonal eſtates as much, the rents of houſes L.4,000,000, and the profits of labour L. 26,000,000. The people of Ireland he reckoned 1,200,000. The corn ſpent in England, at 5*s*. a buſhel for wheat, and 2*s*. 6*d*. for barley, amounts to L.10,000,000 a-year. The navy of England then required 36,000 men to man it, and other trade and ſhipping 48,000. In France, to manage the whole ſhipping trade, there were then required only 1500 men. The whole people of France were 13,500,000; and thoſe of England, Scotland, and Ireland, about 9,500,000. In the three kingdoms are about 20,000 churchmen, and in France more than 270,000. In the dominions of England were above 40,000 ſeamen, and in France not more than 10,000. In England, Scotland, and Ireland, and all their dependencies, there was then about 60,000 ton of ſhipping, worth about 4,500,000 in money. The ſea-line round England, Scotland, and Ireland, and the adjacent iſles, is about 3800 miles. In the whole world he reckoned about 350,000,000 of people; and thoſe with whom the Engliſh and Dutch have any commerce, not more than eighty millions; and the value of

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commodities annually traded for in the whole not above L. 45,000,000. That the manufactures exported from England amounted to about L. 5,000,000 *per annum*; lead, tin, and coals, to L. 500,000 *per annum*. The value of the French commodities then brought into England did not exceed L. 1,200,000 *per annum*; and the whole caſh of England in current money was then about L. 6,000,000 Sterling.

With theſe calculations Dr Davenant was diſſatisfied; and therefore, from the obſervations of Mr Greg. King, he advanced others of his own. He reckons the land of England 39 millions of acres; the number of people 5 millions and a half, increaſing 9000 a year, making allowance for wars, plagues, and other accidents. He reckons the inhabitants of London 530,000; of other cities and market-towns in England 870,000; and thoſe of villages, &c. 4,100,000. The yearly rent of land he reckons L. 10,000,000; of houſes, &c. 2,000,000; the produce of all kinds of grain in a tolerable year L. 9,075,000; the annual rent of corn lands L. 2,200,000, and their net produce L. 9,000,000; the rent of paſture, meadows, woods, foreſts, commons, heaths, &c. L. 7,000,000; the annual produce by cattle in butter, cheeſe, and milk, about L. 2,500,000; the value of the wool yearly ſhorn about L. 2,000,000; of horſes yearly bred about L. 250,000; of the fleſh yearly ſpent as food about L. 3,350,000; of the tallow and hides about L. 600,000; of the hay yearly conſumed by horſes about L. 1,300,000; of the hay conſumed by other cattle L. 1,000,000; of the timber yearly felled for building L. 500,000; and of the wood yearly ſpent in firing, &c. about L. 500,000. The proportion of the land of England to its inhabitants is now about 7¼ acres per head; the value of the wheat, rye, and barley, neceſſary for the ſuſtenance of England, amounts to at leaſt L. 6,000,000 Sterling *per annum*; of the woollen manufacture about L. 8,000,000 *per annum*, and exports of all kinds of the woollen manufacture amount to above L. 2,000,000 *per annum*; the annual income of England, on which the whole people ſubſiſt, and out of which all taxes are paid, is reckoned to be about L. 43,000,000, that of France L. 81,000,000, and of Holland L. 18,250,000. See Davenant's *Eſſay on Trade*, in vol. vi. of his works. For calculations reſpecting mortality, ſee Major Grant's *Obſervations on the Bills of Mortality*, and our article *Bills of Mortality*.

In Vol. XLIX. of the Philoſophical Tranſactions we have an eſtimate of the number of people in England by Dr Brakenridge, from conſidering the number of houſes and quantity of bread conſumed. On the former principle he computes the number of people to be 6,257,418 of all ages, counting in England and Wales 911,310 houſes, and allowing ſix perſons to a houſe. From a ſurvey of the window-lights after the year 1750, the number of houſes charged in England and Wales were 690,000, beſides 200,000 cottages that pay nothing; the whole number therefore was 890,000, and the number of people, allowing ſix to a houſe, 5,340,000. On the latter principle, he eſtimates the number of quarters of wheat conſumed at home to be 2,026,100; and allowing a quarter for three perſons in a year, or ſeven ounces a day for each perſon, he concludes the number of people to be 6,078,300. Of this number, according to Dr Halley's rule, he ſuppoſes about 1,500,000 men able to carry arms. The country he ſuppoſes capable of ſupporting one-half more inhabitants, or 9,000,000; for, according to Mr Templeman's ſurvey, England contains 49,450 ſquare miles, that is, 31,648,000 acres, of which 25,300,000 acres are proper to be cultivated; and allowing three acres, well manured, for the maintenance of one perſon, there will be maintenance in England for 8,430,000 people; to which add the produce of fiſhing, and it will enable the country to ſupport 9,000,000. In Ireland, Mr Templeman reckons 17,536,000 acres, of which Dr Brakenridge thinks 12,000,000 are capable of cultivation; and allowing four acres to each perſon, and the number of inhabitants to be only 1,000,000, Ireland could maintain 2,000,000 more people than it has now. In Scotland, containing 1,500,000 people, and 17,728,000 acres of land, of which there are 11,000,000 good acres, allowing five for each perſon, he ſuppoſes there may be proviſion for 2,200,000 people, or for 700,000 more than there are at preſent. Hence he infers, that were both the Britiſh iſles properly cultivated, there is a proviſion for 6,000,000 inhabitants beyond the preſent number. Extending his ſurvey to the whole globe, he ſuppoſes the whole ſurface to be to the quantity of land as 8 to 3, *i. e.* as 197,819,550 to 74,182,331 ſquare miles; out of which, deducting one-third for waſte-ground, there will be 49,454,887 ſquare miles, or 31,651,127,680 good acres. And ſtating the whole number of inhabitants on the globe to be 400,000,000, there will be 79 good acres to each perſon. See Dr Halley's *Calculations* on the ſame ſubject, and *Dr Price's* (for a liſt of whoſe works ſee his life at the Word Price), and King *on the National Debt*

Political Arithmetic ‖ Polity.

POLITICS, the firſt part of economy or ethics, conſiſting in the well governing and regulating the affairs of a ſtate for the maintenance of the public ſafety, order, tranquillity, and morals.

Lord Bacon divides politics into three parts, viz. the *preſervation* of the ſtate, its *happineſs* and *flouriſhing*, and its *enlargement*. Of the firſt two, he informs us, various authors have treated, but the laſt has never been handled; and he has given a ſpecimen of an eſſay to ſupply the want.

POLITY, or Policy, denotes the peculiar form and conſtitution of the government of any ſtate or nation; or the laws, orders, and regulations, relating thereto *.——Polity differs only from politics, as the theory from the practice of any art.

Of the nature of our ſocial duties, both private and political, we have already ſpoken at ſome length (ſee *Moral Philoſophy*, Part II. chap. iii. and particularly ſect. vii.); and we ſhall have occaſion to take a view of the origin and nature of the ſeveral political eſtabliſhments of Europe, &c. hereafter. (See *Civil Society*.) We ſhall only further remark in this place upon the neceſſity of always joining politics and morality together. This view of the ſubject is indeed antiquated and neglected; but the connection has always been externally reſpected even by thoſe who have ſeparated them the moſt widely. Politics and morality, far from ſtanding in oppoſition to each other, have the moſt intimate connection, and exhibit the relation which the *part* bears to the *whole*; that is to ſay, that politics are only a part or a branch of morality. No truth can be more evident than this;

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* See Government.

for as morality is the guide of human life, the principle of order, and the univerſal ſource of real improvement and genuine happineſs to all mankind, every thing relative to the direction of individuals, or the government of nations, muſt be comprehended within its ſphere, and be ſubſervient to its laws. All the ſchemes and projects of pretended political wiſdom, that deviate from or violate the rules of this maſter-ſcience, turn out in the iſſue often to the detriment of their contrivers, always to that of the nation; and it is a palpable and abſurd error to think of advancing the happineſs of one country at the expence of the general good of mankind. The experience of ages, and the hiſtory of the world, confirm theſe aſſertions; from which, and from daily obſervation, we obtain a convincing proof of the wiſdom of the good old maxim, both in its application to individuals and to nations, that "honeſty is the beſt policy." See Baron Dahlberg's *Conſiderations on the Connection between Morality and Politics*, read by himſelf to the Academy of Sciences at Erfurt.

POLL, a word uſed in ancient writings for the head: hence to poll, is either to vote, or to enter down the names of thoſe perſons who give their votes at an election.

Poll-Evil. See FARRIERY, § xxxii.

Poll-Money, or *Capitation*, a tax impoſed by authority of the Britiſh parliament on the perſon or head; either on all indifferently, or according to ſome known mark or diſtinction, as quality, calling, &c.

Thus, by the ſtatute 18 Car. II. every ſubject in the kingdom was aſſeſſed by the head, or poll, according to his degree; every duke L.100, marquis L.80, baronet L.30, knight L.20, eſquire L.10, &c. and every ſingle private perſon 12d.

This was no new tax, as appears by former acts of parliament.

POLLACHIUS, or POLLACK. See GADUS.

POLLARD, or CROCARD, the name of a ſort of baſe money current in Ireland in the time of Edward I. See *Simon's Hiſtory of Iriſh Coins*, p. 15.

POLLEN, the fecundating or fertilizing duſt contained within the antheræ or tops of the ſtamina, and diſperſed upon the female organ when ripe for the purpoſes of impregnation. See BOTANY.

This duſt, correſponding to the ſeminal fluid in animals is commonly of a yellow colour; and is very conſpicuous in the ſummits of ſome flowers, as the tulip and lily. Its particles are very minute, and of extreme hardneſs. Examined by the microſcope, they are generally found to aſſume ſome determinate form, which often predominates, not only through all the ſpecies of a particular genus, but alſo through the genera of a natural family or order. The powder in queſtion being triturated, and otherwiſe prepared in the ſtomach of bees, by whom great quantities are collected in the hairy bruſhes with which their legs are covered, is ſuppoſed by ſome authors to produce the ſubſtance known by the name of *wax;* a ſpecies of vegetable oil, rendered concrete by the preſence of an acid, which muſt be removed before the ſubſtance can be rendered fluid.

POLLENTIA, a town or colony of Roman citizens in the Balearis Major. It is now ſaid to be Alcudia, ſituated on the north-eaſt ſide of the iſland Majorca. There was another *Pollentia* of the Picenum, likewiſe a colony. It is thought to be either the ſame with or near to the Urbs Salvia, but is now extinct. There was a third of Liguria, ſituated at the confluence of the Stura and Tanarus. Suetonius calls it a municipium, and the people *Pollentina Plebs*. It was famous for its abundance of black fleeces; but was afterwards, under Arcadius and Honorius, ſtained with a defeat rather of the Romans under Stilico than of the Goths under Alaricus, though palliated by Claudian the poet; after which Rome was taken and ſet on fire. It is now called *Solenza*, a ſmall town of Piedmont, not far from Aſti.

POLLEX, in anatomy, denotes either the thumb or great toe, according as *manus* or *pedis* is added to it.

POLLICHIA, in botany: A genus of the monogynia order, belonging to the monandria claſs of plants; and in the natural method ranking with thoſe that are doubtful. Of this there is only one ſpecies, *viz.* the *campeſtris*, or whorl-leaved pollichia, a native of the Cape of Good Hope, and flowers in September.

POLLICIPES, the TOE-SHELL, in natural hiſtory, is the name of a genus of ſhells, the characters of which are theſe: they are multivalve flat ſhells, of a triangular figure, each being compoſed of ſeveral laminæ, which end in a ſharp point. They ſtand upon pedicles, and are furniſhed with a great number of hairs. We have only one known ſpecies of this genus, which is always found in large cluſters.

POLLICIS PRESSIO, and POLLICIS VERSIO, were uſed at the combats of gladiators as ſignals of life or death to the vanquiſhed combatant; or to the victor to ſpare or take the life of his antagoniſt. The *pollicis preſſio*, by which the people granted life to the proſtrate gladiator, was no more than a clenching of the fingers of both hands together, and ſo holding the two thumbs upright cloſe together. The *pollicis verſio*, which authoriſed the victor to kill the other as a coward, was the bending back of the thumbs. Such is Dacier's opinion; but others ſay the *pollicis preſſio* was when the people held up one hand with the thumb bent, and the *pollicis verſio* when they ſhowed the hand with the thumb raiſed. Authors, however, are not perfectly agreed, though the phraſes *pollicem premere*, and *pollicem vertere*, frequently occur in the Latin claſſics as indications of the people's will that a gladiator ſhould live or die.

POLLIO (Caius Aſinius), a celebrated Latin poet and orator, was of conſular dignity, and compoſed ſome tragedies which were eſteemed, but are now loſt. He was the firſt who opened at Rome a library for the uſe of the public. He was the friend of Mark Antony; which prevented his complying with the ſolicitations of Auguſtus, who preſſed him to embrace his party. At length Auguſtus having wrote ſome verſes againſt Pollio, he was urged to anſwer them: on which he ſaid, "I ſhall take care of writing againſt a man who has the power of proſcribing us." He is praiſed by Virgil and Horace, whoſe patron he was.

There was another *Pollio*, a friend of Auguſtus, who uſed to feed his fiſhes with human fleſh. This cruelty was diſcovered when one of his ſervants broke a glaſs in the preſence of Auguſtus, who had been invited to a feaſt. The maſter ordered the ſervant to be ſeized, but he threw himſelf at the feet of the emperor, and begged him to interfere, and not to ſuffer him to be devoured by fiſhes. Upon this the cauſes of his apprehenſion were examined; and Auguſtus, aſtoniſhed at the barbarity of his favourite, cauſed the ſervant to be diſmiſſed, all the fiſh ponds to be filled up, and the cryſtal glaſſes of Pollio to be broken to pieces.

POLLUTION, in general, ſignifies defilement, or the rendering a perſon or place unclean or unholy. For the Jewiſh pollutions, ſee the article Impurity.

The Romaniſts hold a church to be polluted by the effuſion of blood or of ſeed therein: and that it muſt be conſecrated anew. And the Indians are ſo ſuperſtitious on this head, that they break all the veſſels which thoſe of another religion have drank out of, or even only touched; and drain all the water out of a pond in which a ſtranger has bathed.

Pollution, in medicine, a diſeaſe which conſiſts in an involuntary emiſſion of the ſeed in time of ſleep. This, in different perſons, is very different in degree; ſome being affected with it only once in a week, a fortnight, three weeks, or a month, and others being ſubject to it almoſt every night. The perſons moſt ſubject to it, are young men of a ſanguineous temperament, who feed high and lead a ſedentary life. When this happens to a perſon but once in a fortnight or a month, it is of no great conſequence; but when it happens almoſt every night, it greatly injures the health; the patient looks pale and ſickly; in ſome the eyes become weak and inflamed, are ſometimes affected with violent defluctions, and are uſually at laſt encircled with a livid appearance of the ſkin. This diſtemper is to be cured rather by a change of life than by medicines. When it has taken its riſe from a high diet and a ſedentary life, a coarſer food and the uſe of exerciſe will generally cure it. ' Perſons ſubject to this diſeaſe ſhould never take any ſtimulating purges, and muſt avoid as much as poſſible all violent paſſions of the mind: and though exerciſe is recommended in moderation, yet if this be too violent, it will rather increaſe the diſorder than contribute to its cure.

Self-Pollution. See Onanism.

POLLUX (Julius), a Greek writer of antiquity, flouriſhed in the reign of the emperor Commodus, and was born at Naucrates, a town in Egypt. He was educated under the ſophiſts, and made great progreſs in grammatical and critical learning. He taught rhetoric at Athens, and became ſo famous that he was made preceptor of the emperor Commodus. He drew up for his uſe, and inſcribed to him, while his father Marcus Antoninus was living, an *Onomaſticon* or Greek Vocabulary, divided into ten books. It is extant, and contains a vaſt variety of ſynonymous words and phraſes, agreeably to the copiouſneſs of the Greek tongue, ranged under the general claſſes of things. It was intended to facilitate the knowledge of the Greek language to the young prince; and it is ſtill very uſeful to all who have a mind to be perfect in it. The firſt edition of it was printed at Venice by Aldus in 1502, and a Latin verſion was afterwards made and publiſhed with it: but there was no correct and handſome edition of it till that of Amſterdam, 1706, in folio, by Lederlinus and Hemſterhuſius. Lederlinus went through the firſt ſeven books, correcting the text and verſion, and ſubjoining his own, with the notes of Salmaſius, Iſ. Voſſius, Valeſius, and of Kuhnius, whoſe ſcholar he had been, and whom he ſucceeded in the profeſſorſhip of the oriental languages in the univerſity of Straſburg. Hemſterhuſius continued the ſame method through the three laſt books: this learned man has ſince diſtinguiſhed himſelf by an excellent edition of Lucian, and other monuments of ſolid and profound literature.

Pollux wrote many other things, none of which remain. He lived to the age of 58. Philoſtratus and Lucian have treated him with much contempt and ridicule. *Philoſtrat. de vit. Sophiſt.* lib. ii. and *Lucian in Rhetorum præceptorem.*

Pollux. See Castor and Pollux.

Pollux, in aſtronomy, a fixed ſtar of the ſecond magnitude in the conſtellation Gemini, or the Twins. See Castor.

Pollux and Caſtor, a fiery meteor. See *Castor and Pollux.*

POLOCSKI, a palatinate in the duchy of Lithuania, bounded on the north by the palatinate of Weytepſki, on the ſouth by the Dwina, on the north by Muſcovy, and on the weſt by Livonia. It is a deſert country full of wood, and had formerly its own dukes.

Polocski, a town of Lithuania, and capital of a palatinate of the ſame name, with two caſtles to defend it. It was taken by the Muſcovites in 1563, and retaken the ſame year. It is ſeated on the river Dwina, 50 miles ſouth-weſt of Weytepſki, and 80 eaſt of Braſlaw. E. Long. 29. 0. N. Lat. 56. 4.

POLTROON, or Poltron, a coward or daſtard, wanting courage to perform any thing great or noble. The word is borrowed from the French, who according to Salmaſius, derive it *a pollice truncato*; becauſe anciently thoſe who would avoid going to the wars cut off their thumb. But Menage, with more probability, derives it from the Italian *poltrone*, and that from *poltro* a "bed;" becauſe timorous, puſillanimous people take pleaſure in lying a-bed. Others chooſe to derive the word from the Italian *poltro* a "colt;" becauſe of that creature's readineſs to run away.

POLVERINE, the calcined aſhes of a plant; of a ſimilar nature with our pot-aſhes or pearl-aſhes. It is brought from the Levant and Syria; and in the glaſs-trade it is always to be preferred to any other aſhes. The barilla, or pot-aſhes of Spain, yield more pure ſalt than the polverine of the Levant, but the glaſs made with it has always ſome blue tinge: that made with the polverine is perfectly white, which ought always to be uſed for the fineſt cryſtal.

POLYADELPHIA (from πολυς *many*, and αδελφια *brotherhood)*, many brotherhoods. The name of the 18th claſs of Linnæus's ſexual ſyſtem, conſiſting of plants with hermaphrodite flowers, in which ſeveral ſtamina or male organs are united by their filaments into three or more diſtinct bundles.

POLYÆNUS, the name of many famous men recorded in ancient writers. Among them was Julius Polyænus, of whom we have ſome Greek epigrams extant in the firſt book of the *Anthologia*. The Polyænus whom it moſt concerns us to know about, is the author of the eight books of the Stratagems of illuſtrious Commanders in War. He was probably a Macedonian, and perhaps a ſoldier in the early part of his life; but of this there is no certainty. He was undoubtedly a rhetorician and a pleader of cauſes; and appears, from the dedication of his work to the emperors Antoninus and Verus, to have lived towards the latter part of the ſecond century. The *Stratagemata* were publiſhed in Greek by Iſaac Caſaubon, with notes, in 1589, 12mo; but no good edition of them appeared till that of Leyden, 1690, in 8vo. The title-page runs thus: *Polyæni Stratagematum libri octo, Juſto Vulteio interprete, Pancratius Maaſvicius recenſuit, Iſaaci Caſauboni nec non ſuas notas adjecit.*

We have in this work the various ſtratagems of above 300 captains and generals of armies, chiefly Greeks and barbarians: for the Romans ſeldom uſed ſuch fineſſes; and Polyænus has ſhown further, that he was not well verſed in Roman affairs. A great number of theſe ſtratagems appear to us to be ridiculous or impracticable; and neither the generals, nor even common ſoldiers of our days, would be found ſimple enough to be caught by them. Few of this order are capable of reading *Polyænus's Stratagems*; and if they were, they would reap little benefit from it. The book is uſeful to ſuch as ſtudy the Greek language and antiquity; for many things will be found in it, illuſtrating the cuſtoms and opinions of ancient times. The ſixth and ſeventh books are imperfect.

Polyænus compoſed other works beſides the *Stratagemata.* Stobœus has produced ſome paſſages out of a book *De Republica Macedonum*; and Suidas mentions a piece concerning the Thebans and three books of Tacitus. If death had not prevented, he would have written *Memorabilia of the Emperors Antoninus and Verus*: for he makes a promiſe of this in the preface to his ſixth book of *Stratagems*. Caſaubon, in the dedication of Polyænus to Mornæus, calls him *an elegant, acute, and learned writer*.

POLYANDRIA (from πολυς *many*, and ανηρ a *man* or *huſband)*, many huſbands. The name of the 13th claſs in Linnæus's ſexual method, conſiſting of plants with hermaphrodite flowers, which are furniſhed with ſeveral ſtamina, that are inſerted into the common receptacle of the flower.

POLYANTHEA, a collection of common-places in alphabetical order, for the uſe of orators, preachers, &c. The word is formed from the Greek πολυς *much*, and ανθος *flower*; and has much the ſame meaning with *anthology* or *florilege*. The firſt author of the polyanthea was Dominic Nanni de Mirabellio, whoſe labour has been improved on by Barth. Amantius, and Franc. Torſius; and ſince theſe, by Joſ. Langius, under the title of *Polyanthea nova*, 1613.

POLYANTHUS, in botany. See PRIMULA.

POLYBIUS, a famous Greek hiſtorian, was born at Megalopolis, a city of Arcadia, 205 years before Chriſt; and was the ſon of Lycortas, chief of the republic of the Achæans. He was trained to arms under the celebrated Philopœmen, and is deſcribed by Plutarch carrying the urn of that great but unfortunate general in his funeral proceſſion. He aroſe to conſiderable honours in his own country, but was compelled to viſit Rome with other principal Achæans, who were detained there as pledges for the ſubmiſſion of their ſtate. From hence he became intimate with the ſecond Scipio Africanus, and was preſent with him at the demolition of Carthage. He ſaw Corinth alſo plundered by Mummius, and thence paſſing through the cities of Achaia, reconciled them to Rome. He extended his travels into Egypt, France, and Spain, that he might avoid ſuch geographical errors as he has cenſured in others.

It was in Rome that he compoſed his excellent hiſtory, for the ſake of which his travels were undertaken. This hiſtory was divided into 40 books; but there only remains the five firſt, with extracts of ſome parts of the others. It has had ſeveral editions in Greek and Latin; and there is an Engliſh tranſlation by Mr Hampton. He died at the age of 82.

POLYCARP, one of the moſt ancient fathers of the Chriſtian church, was born towards the end of the reign of Nero, probably at Smyrna; where he was educated at the expence of Caliſta, a noble matron diſtinguiſhed by her piety and charity. He was unqueſtionably a diſciple of St John the Evangeliſt, and converſed familiarly with other of the apoſtles. When of a proper age, Bucolus ordained him a deacon and catechiſt of his church; and upon his death he ſucceeded him in the biſhopric, to which he is ſaid to have been conſecrated by St John, who alſo directed his Apocalypſe, among others, to him, under the title of *the angel of the church of Smyrna*. At length the controverſy about the obſervation of Eaſter beginning to grow high between the eaſtern and weſtern churches, he went to Rome to diſcourſe with thoſe who were of the oppoſite party. The ſee was then poſſeſſed by Anicetus, with whom he had many conferences, that were carried on in the moſt peaceable and amicable manner; and though neither of them could bring the other to embrace his opinion, they both retained their own ſentiments without violating that charity which is the great law of their religion.

Whilſt at Rome he particularly oppoſed the hereſies of Marcian and Valentinus. His conduct on this occaſion is related by Irenæus; who informs us, that when Polycarp paſſed Marcian in the ſtreet without ſpeaking, Marcian ſaid, "Polycarp, own us!" To which he replied with indignation, "I own thee to be the firſt-born of Satan." Irenæus adds, that when any heretical doctrines were ſpoken in his preſence, he would ſtop his ears and ſay, "Good God! to what times haſt thou reſerved me, that I ſhould hear ſuch things!" and immediately left the place. He was wont to tell, that St John, going into a bath at Epheſus, and finding Cerinthus the heretic in it, immediately ſtarted back without bathing, crying out, "Let us run away, leſt the bath ſhould fall upon us while Cerinthus the enemy of truth is in it." Polycarp governed the church of Smyrna with apoſtolic purity, till he ſuffered martyrdom in the 7th year of Marcus Aurelius; the manner of which is thus related.

The perſecution waxing hot at Smyrna, and many having ſealed their faith with their blood, the general cry was, "Away with the impious; let Polycarp be ſought for." Upon which he privately withdrew into a neighbouring village, where he continued for ſome time praying night and day for the peace of the church. He was thus employed, when one night he fell into a trance, and dreamed that his pillow took fire, and was burnt to aſhes; which, when he awoke, he told his friends was a preſage that he ſhould be burnt alive for the cauſe of Chriſt. Three days afterwards, in order to eſcape the inceſſant ſearch for him, he retired into another village: his enemies, however, were at hand, who ſeized upon two youths (one of whom they forced by ſtripes to a confeſſion), by whom they were conducted to his lodging. He might have ſaved himſelf by getting into another houſe; but he ſubmitted, ſaying, "The will of the Lord be done." He therefore came down from his bed-chamber, and ſaluting his perſecutors with a ſerene and cheerful countenance, he ordered a table to be ſet with proviſions, invited them to partake of them, and only requeſted for himſelf one hour for prayer; after which he was ſet upon an aſs, and conducted towards Smyrna. On the road he met Herod an irenarch or juſtice of the province, and his father, who were the principal inſtigators of the perſecution. Herod took him up into his chariot, and ſtrenuouſly endeavoured to undermine his conſtancy; but having failed in the attempt, he thruſt him out of the chariot with ſo much violence and indignation, that he bruiſed his thigh with the fall. When at the place of execution, there came, as is ſaid, a voice from heaven, ſaying, "Polycarp, be ſtrong, and quit thyſelf like a man." Before the tribunal he was urged to ſwear by the genius of Cæſar. "Repent (ſays the proconſul), and ſay with us, take away the impious." Whereupon the martyr looking round at the crowd with a ſevere and angry countenance, beckoned with his hand, and looking up to heaven, ſaid with a ſigh, in a very different tone from what they meant, "Take away the impious." At laſt, confeſſing himſelf to be a Chriſtian, the crier thrice proclaimed his confeſſion, and the people ſhouted, "This is the great doctor of Aſia, and the father of the Chriſtians; this is the deſtroyer of our gods, that teaches men not to do ſacrifice, or worſhip the deities." When the fire was prepared, Polycarp requeſted not to be nailed, as uſual, but only tied to the ſtake; and after a ſhort prayer, which he pronounced with a clear and audible voice, the executioner blew up the fire, which increaſing to a mighty flame, "Behold a wonder ſeen (ſays my author) by us who were purpoſely reſerved, that we might declare it to others; the flames diſpoſing themſelves, into the reſemblance of an arch, like the ſails of a ſhip ſwelled with the wind, gently encircled the body of the martyr, who ſtood all the while in the midſt, not like roaſted fleſh, but like the gold or ſilver purified in the furnace, his body ſending forth a delightful fragrancy, which, like frankincenſe or ſome other coſtly ſpices, preſented itſelf to our ſenſes. The infidels, exaſperated by the miracle, commanded a ſpearman to run him through with a ſword: which he had no ſooner done, but ſuch a vaſt quantity of blood flowed from the wound as extinguiſhed the fire; when a dove was ſeen to fly from the wound, which ſome ſuppoſe to have been his ſoul, clothed in a viſible ſhape at the time of its departure (A)." The Chriſtians endeavoured to carry off his body entire, but were not allowed by the irenarch, who commanded it to be burnt to aſhes. The bones, however, were gathered up, and decently interred by the Chriſtians.

Thus died St Polycarp, the 7th of the kalends of May, A. C. 167. The amphitheatre on which he ſuffered was moſtly remaining not many years ago; and his tomb, which is in a little chapel in the ſide of a mountain, on the ſouth-eaſt of the city, was ſolemnly viſited by the Greeks on his feſtival day; and for the maintenance and repairing of it, travellers were wont to throw a few aſpers into an earthen pot that ſtands there for the purpoſe. He wrote ſome homilies and epiſtles, which are now loſt, except that to the Philippians, which is a truly pious and Chriſtian piece, containing ſhort and uſeful precepts and rules of life, which St Jerome informs us was even in his time read in the public aſſemblies of the Aſiatic churches. It is ſingularly uſeful in proving the authenticity of the books of the New Teſtament; for he has ſeveral paſſages and expreſſions from Matthew, Luke, the Acts, St Paul's Epiſtles to the Philippians, Epheſians, Galatians, Corinthians, Romans, Theſſalonians, Coloſſians, 1ſt Timothy, 1ſt Epiſtle of St John, and 1ſt of Peter; and makes particular mention of St Paul's Epiſtle to the Epheſians. Indeed his whole Epiſtle conſiſts of phraſes and ſentiments taken from the New Teſtament (B).

POLYCARPON, in botany: A genus of the trigynia order, belonging to the triandria claſs of plants; and in the natural method ranking under the 22d order, *Caryophyllei*. The calyx is pentaphyllous; there are five very ſmall ovate petals; the capſule is unilocular and trivalved.

POLYCHREST, in pharmacy, ſignifies a medicine that ſerves for many uſes, or that cures many diſeaſes.

Sal Polychrest, a compound ſalt made of equal parts of ſaltpetre and ſulphur, deflagrated in a red-hot crucible.

POLYCNEMUM, in botany: A genus of the monogynia order, belonging to the triandria claſs of plants; and in the natural method ranking under the 12th order, *Holoraceæ*. The calyx is triphyllous; and there are five calciform petals, with one ſeed almoſt naked.

POLYCRATES, was a tyrant of Samos, famous for the good fortune which always attended him. He became very powerful; and got poſſeſſion not only of the neighbouring iſlands, but alſo of ſome cities on the coaſt of Aſia. He had a fleet of 100 ſhips of war and was ſo univerſally eſteemed, that Amaſis the king of Egypt made a treaty of alliance with him. The Egyptian king was, however, afraid of his continued proſperity, and adviſed him to chequer his enjoyments, by relinquiſhing ſome of his moſt favourite objects. Polycrates, in compliance, threw into the ſea a beautiful ſeal, the moſt valuable of his jewels. The loſs of ſo precious a ſeal afflicted him for ſome time; but ſoon after he received as a preſent a large fiſh, in whoſe belly it was found. Amaſis no ſooner heard this, than he gave up all alliance with the tyrant of Samos, and obſerved, that ſooner or later his good fortune would vaniſh. Some time after Polycrates viſited Magneſia on the Mæander, where he had been invited by Orontes the governor. Here he was ſhamefully put to death, merely becauſe the governor wiſhed to terminate his proſperity. The

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(A) The miraculous part of this account is ridiculed by Dr Middleton in his Free Enquiry and Defence of it; but ſomething is offered in its favour by Mr Jortin, who obſerves, "the circumſtances are ſufficient only to create a pauſe and a doubt." *Remarks on Eccl. Hiſt.* vol. i.

(B) Jortin, vol. i. p. 68. who to the particulars made out by Cotelerius, has added one from Galat. iv. 26. and another from Hebr. iv. 12, 13.

daughter of Polycrates had diſſuaded her father from going to the houſe of Orontes, on account of the bad dreams which ſhe had, but in vain.

POLYCROTA, in the naval architecture of the ancients, is a word uſed to expreſs ſuch of their galleys as had three, four, five, or more tiers of rowers, ſeated at different heights; they were diſtinguiſhed by this term from the *monocrota*, or thoſe which had only ſingle rows of oars. The number of rows of rowers in the polycrote galleys has given occaſion to ſome to ſuppoſe thoſe veſſels of ſuch a height from the water as is ſcarce credible. Commentators are not at all agreed upon the conſtruction of theſe veſſels.

POLYDAMAS, was a famous athlete, who imitated Hercules in whatever he did. He killed a lion with his fiſt, and it is reported he could ſtop a chariot with his hand in its moſt rapid courſe. He was one day with ſome of his friends in a cave, when on a ſudden a large piece of rock came tumbling down, and while all fled away he attempted to receive the falling fragment in his arms. His prodigious ſtrength, however, was inſufficient, and he was inſtantly cruſhed to pieces under the rock.

POLYDECTES, a ſon of Magnes, was king of the iſland of Seriphos. He received with great kindneſs Danae and her ſon Perſeus, who had been expoſed on the ſea by Acriſius. He took great care of the education of Perſeus; but becoming enamoured of Danae, he removed her from his kingdom, apprehenſive of his reſentment. He afterwards paid his addreſſes to Danae; and being rejected, he prepared to offer her violence. Danae fled to the altar of Minerva for protection; and Dictys, the brother of Polydectes, who had himſelf ſaved her from the ſea-waters, oppoſed her raviſher, and armed himſelf in her defence. At this critical moment Perſeus arrived; and with Meduſa's head he turned into ſtones Polydectes, with the aſſociates of his guilt. The crown of Seriphos was given to Dictys, who had ſhown himſelf ſo active in the cauſe of innocence.

POLYDORE virgil. See Virgil.

POLYDORUS, a ſon of Priam by Hecuba, or, according to others, by Laothoe, the daughter of Altes, king of Pedaſus. Being young and inexperienced when Troy was beſieged by the Greeks, his father removed him to the court of Polymneſtor, king of Thrace, to whoſe care he entruſted the greateſt part of his treaſures, till his country ſhould be freed from foreign invaſion. On the death of Priam, Polymneſtor made himſelf maſter of the riches which were in his poſſeſſion; and to enſure them the better, he murdered the young prince, and threw his body into the ſea, where it was found by Hecuba. According to Virgil, his body was buried near the ſhore by his aſſaſſin; and there grew on his grave a myrtle, whoſe boughs dropped blood, when Æneas going to Italy, attempted to tear them from the tree.

POLYGALA, milkwort: A genus of the octandria order, belonging to the diadelphia claſs of plants; and in the natural method ranking under the 33d order, *Lomentaceæ*. The calyx is pentaphyllous, with two of its leaflets wing-ſhaped and coloured; the legumen is obcordate and bilocular. There are 24 ſpecies; of which the moſt remarkable are,

1. The vulgaris, or common milkwort, is a native of the Britiſh heaths and dry paſtures. The ſtalks are about five or ſix inches long, ſeveral ariſing from the ſame root: the leaves are firm, ſmooth, entire, and grow alternate upon the ſtalks, which are terminated with ſpikes of flowers, moſt commonly blue, but often red or white: the calyx conſiſts of five leaves, three of which are ſmall and green, two below, and one above the corolla; the other two intermediate ones are large, oval, flat-coloured, veined, and reſemble petals, which at length turn greeniſh, and remain a defence to the ſeed-veſſel; the corolla conſiſts of three petals folded together, and forming a tube: the carina is terminated by a kind of heart-ſhaped, concave appendage, fringed at the extremity. The root of this plant has a bitter taſte, and has been found to poſſeſs the virtues of the American rattleſnake-root. It purges without danger, and is alſo emetic and diuretic; ſometimes operating all the three ways at once. A ſpoonful of the decoction made by boiling an ounce of the herb in a pint of water till one half has exhaled, has been found ſerviceable in pleuriſies and fevers, by promoting a diaphoreſis and expectoration; and three ſpoonfuls of the ſame, taken once an hour, has proved beneficial in the dropſy and anaſarca. It has alſo been found ſerviceable in conſumptive complaints.

2. The ſenega, or ſeneka, rattleſnake-wort, grows naturally in moſt parts of North America. This hath a perennial root compoſed of ſeveral fleſhy fibres, from which ariſe three or four branching ſtalks which grow erect, garniſhed with ſpear-ſhaped leaves placed alternately. The flowers are produced in looſe ſpikes at the end of the branches: they are ſmall, white, and ſhaped like thoſe of the common ſort. It flowers in July, but the plants do not produce ſeeds. The root of this ſpecies operates more powerfully than the laſt; but beſides the virtues of a purgative, emetic, and diuretic, it has been recommended as an antidote againſt the poiſon of a rattleſnake; but this opinion is now exploded. It ſtill, however, maintains its character in ſeveral diſorders. Its efficacy, particularly in pleuriſies, is moſt fully eſtabliſhed in Virginia: formerly near 50 out of 100 died of that diſtemper, but by the happy uſe of this root hardly three out of the ſame number have been loſt.

As the ſeeds of the rattleſnake-wort ſeldom ſucceed even in the countries where the plant is a native, the beſt method of propagating it in Europe is to procure the roots from America, and plant them in a bed of light earth in a ſheltered ſituation, where they will thrive without any other culture than keeping them free from weeds. But though the plant will ſtand out ordinary winters, it will be proper to cover it during that ſeaſon with old tanner's bark, or other mulch, to keep out the froſt.

POLYGAMIA (πολυς *many*, and γαμος *marriage*). This term, expreſſing an intercommunication of ſexes, is applied, by Linnæus, both to plants and flowers. A polygamous plant is that which bears both hermaphrodite flowers and male or female, or both.

POLYGAMY, a plurality of wives or huſbands, in the poſſeſſion of one man or woman at the ſame time.

Polygamy is ſo univerſally eſteemed unlawful, and even unnatural, through Europe, and in all Chriſtian countries, that we have generally reaſoned upon this conviction. Both religion and reaſon appear at firſt ſight at leaſt to condemn it; and with this view of the ſubject mankind in general reſt ſatisfied: but ſome bolder geniuſes have taken the oppoſite ſide of the queſtion; have caſt off the prejudices of education, and attempted to ſhow that polygamy is not unlawful, but that it is juſt and neceſſary, and would be a public benefit. Such writers, to uſe the words of an intelligent critic[*], "recur to the common ſubterfuge, of which every *ſetter up of ſtrange gods*, and every CONSCIENTIOUS troubler of the public peace, have artfully availed themſelves to ſilence the clamour of expoſtulation. 'TRUTH! TRUTH!' is their general cry: and with this hopeful pretence, prudence and humility, and every amiable and uſeful virtue; are left behind; while CONSCIENCE (*conſcience!*) blindly ruſhes forward to oppoſe order, inſult authority, and overturn the cuſtoms of ages."

But notwithſtanding theſe fair pretences, it will, we doubt not, be eaſy to ſhow that truth is not upon their ſide; prudence and delicacy are certainly at open war with them: for Dr Percival, Phil. Tranſ. vol. lxvi. part i. p. 163. has very juſtly obſerved, that the practice is brutal, deſtructive to friendſhip and moral ſentiment, inconſiſtent with one great end of marriage, the education of children, and ſubverſive of the natural rights of more than half of the ſpecies. Beſides, it is injurious to population, and therefore can never be countenanced or allowed in a well-regulated ſtate; for though the number of females in the world may conſiderably exceed the number of males, yet there are more men capable of propagating their ſpecies than women capable of bearing children; and it is a well-known fact, that Armenia, in which a plurality of wives is not allowed, abounds more with inhabitants than any other province of the Turkiſh empire.

Indeed it appears, that in ſome countries where it is allowed, the inhabitants do not take advantage of it. "The Europeans (ſays M. Niebuhr[†]) are miſtaken in thinking the ſtate of marriage ſo different among the Muſſulmans from what it is with Chriſtian nations. I could not diſcern any ſuch difference in Arabia. The women of that country ſeem to be as free and as happy as thoſe of Europe can poſſibly be. Polygamy is permitted, indeed, among Mahometans, and the delicacy of our ladies is ſhocked at this idea; but the Arabians rarely avail[‡] themſelves of the privilege of marrying four lawful wives, and entertaining at the ſame time any number of female ſlaves. None but rich voluptuaries marry ſo many wives, and their conduct is blamed by all ſober men. Men of ſenſe, indeed, think this privilege rather troubleſome than convenient. A huſband is by law obliged to treat his wives ſuitably to their condition, and to diſpenſe his favours among them with perfect equality: but theſe are duties not a little diſagreeable to moſt Muſſulmans; and ſuch modes of luxury are too expenſive to the Arabians, who are ſeldom in eaſy circumſtances. I muſt, however, except one caſe; for it ſometimes happens that a man marries a number of wives in the way of commercial ſpeculation. I know a Mullah, in a town near the Euphrates, who had married four wives, and was ſupported by the profits of their labour."

See a curious kind of polygamy under the article NAYRES. The ancient Britons, too, had a kind of polygamy among them, 12 women being common to 12 men.

Selden has proved, in his *Uxor Hebraica*, that plurality of wives was allowed of, not only among the Hebrews, but alſo among all other nations, and in all ages. It is true, the ancient Romans were more ſevere in their morals, and never practiſed it, though it was not forbid among them: and Mark Antony is mentioned as the firſt who took the liberty of having two wives.

From that time it became pretty frequent in the empire till the reigns of Theodoſius, Honorius, and Arcadius, who firſt prohibited it by expreſs law in 393. After this the emperor Valentinian, by an edict, permitted all the ſubjects of the empire if they pleaſed, to marry ſeveral wives; nor does it appear, from the eccleſiaſtical hiſtory of thoſe times, that the biſhops made any oppoſition to this introduction of polygamy. In effect, there are ſome even among the Chriſtian caſuiſts who do not look on polygamy as in itſelf criminal. Jurieu obſerves, that the prohibition of polygamy is a poſitive law; but from which a man may be exempted by ſovereign neceſſity. Baillet adds, that the example of the patriarchs is a very powerful argument in favour of polygamy: of theſe arguments we ſhall ſpeak hereafter.

It has been much diſputed among the doctors of the civil law whether polygamy be adultery. In the Roman law it is called *ſtuprum*, and puniſhed as ſuch, that is, in ſome caſes, capitally. But a ſmaller puniſhment is more conſiſtent with the Jewiſh law, wherein the prohibition of adultery is perpetual, but that of polygamy temporary only.

In Germany, Holland, and Spain, this offence is differently puniſhed. By a conſtitution of Charles V. it was a capital crime. By the laws of ancient and modern Sweden it is puniſhed with death. In Scotland it is puniſhed as perjury.

In England it is enacted by ſtatute 1 Jac. I. cap. 11. that if any perſon, being married, do afterwards marry again, the former huſband or wife being alive, it is felony, but within the benefit of clergy. The firſt wife in this caſe ſhall not be admitted as an evidence againſt her huſband, becauſe ſhe is the true wife; but the ſecond may, for ſhe is indeed no wife at all; and ſo *vice verſa* of a ſecond huſband. This act makes an exception to five caſes, in which ſuch ſecond marriage, tho' in the three firſt it is void, is, however, no felony. 1. Where either party hath been continually abroad for ſeven years, whether the party in England had notice of the other's being living or not. 2. Where either of the parties hath been abſent from the other ſeven years within the kingdom, and the remaining party hath had no notice of the other's being alive within that time. 3. Where there is a divorce or ſeparation *a menſa et thora* by ſentence in the eccleſiaſtical court. 4. Where the firſt marriage is declared abſolutely void by any ſuch ſentence, and the parties looſed *a vinculo*. Or, 5. Where either of the parties was under the age of conſent at the time of the firſt marriage; for in ſuch caſe the firſt marriage was voidable by the diſagreement of either party, which this ſecond marriage very clearly amounts to. But if at the age of conſent the parties had agreed to the marriage which completes the contract, and is indeed the real marriage, and afterwards one of them ſhould marry again, judge Blackſtone apprehends that ſuch ſecond marriage would be within the reaſon and penalties of the act.

Bernardus Ochinus, general of the order of Capuchins, and afterwards a Proteſtant, publiſhed, about the middle of the 16th century, Dialogues in favour of Polygamy, which where anſwered by Theodore Beza. And about the concluſion of the laſt century we had at London an artful treatiſe publiſhed in behalf of a plurality of wives, under the title of *Polygamia Triumphatrix:* the author whereof aſſumes the name of *Theophilus Aletheus;* but his true name was *Lyſerus.* He was a native of Saxony. It has been anſwered by ſeveral.

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[*] Monthly Review, vol. 63, p. 274.

[†] Heron's Tranſlation of Niebuhr's Travels.

[‡] See Hindoos, nº 9.

A new argument in favour of polygamy has been adduced by Mr Bruce, on this principle, that in ſome parts of the world the proportion of female children is much greater than that of males. "From a diligent inquiry (ſays he) into the ſouth and ſcripture-part of Meſopotamia, Armenia, and Syria, from Mouſul or Nineveh to Aleppo and Antioch, I find the proportion to be fully two women to one man. There is indeed a fraction over, but it is not a conſiderable one. From Latikea, Laodicea *ad mare*, down the coaſt of Syria to Sidon, the number is nearly three, or two and three fourths, to one man. Through the Holy Land, the country called *Horan*, in the Iſthmus of Suez, and the parts of the Delta unfrequented by ſtrangers, it is ſomething leſs than three. But from Suez to the Straits of Babelmandel, which contains the three Arabias, the proportion is fully four women to one man; which I have reaſon to believe holds as far as the line, and 30° beyond it. The Imam of Sama was not an old man when I was in Arabia Felix in 1769; but he had 88 children then alive, of whom 14 only were ſons. The prieſt of the Nile had 70 and odd children; of whom, as I remember, above 50 were daughters.

"It may be objected, that Dr Arburthnot, in quoting the bills of mortality for 20 years, gave the moſt unexceptionable grounds for his opinion; and that my ſingle aſſertion of what happens in a foreign country, without further foundation, cannot be admitted as equivalent teſtimony: and I am ready to admit this objection, as there are no bills of mortality in any of theſe countries. I ſhall therefore ſay in what manner I attained the knowledge which I have juſt mentioned. Whenever I went into a town, village, or inhabited place, dwelt long in a mountain, or travelled journeys with any ſet of people, I always made it my buſineſs to inquire how many children they had, or their fathers, their next neighbours or acquaintance. I then aſked my landlord at Sidon, ſuppoſe him a weaver, how many children he has had? He tells me how many ſons and how many daughters. The next I aſk is a tailor, a ſmith, &c. in ſhort every man who is not a ſtranger, from whom I can get the proper information. I ſay, therefore, that a medium of both ſexes, ariſing from three or four hundred families, indiſcriminately taken, ſhall be the proportion in which one differs from the other; and this, I am confident, will give the reſult to be three women in 50° of the 90° under every meridian of the globe."

Our author corroborates this argument by ſuppoſing that Mahomet perceived this diſproportion, and that upon it he founded his inſtitution allowing one man to have four wives. "With this view he enacted, or rather revived, the law which gave liberty to every individual to marrry four wives, each of whom was to be equal in rank and honour, without any preference but what the predilection of the huſband gave her."

Having thus eſtabliſhed, as he ſuppoſes, the neceſſity of polygamy in the Eaſt, Mr Bruce proceeds to conſider whether there is not ſome other reaſons why it ſhould not be practiſed in Britain farther than the mere equality in numbers of the ſexes to one another. This reaſon he finds in the difference between the conſtitutions of the Europeans and eaſtern nations. "Women in England (ſays he) are capable of child-bearing at 14; let the other term be 48, when they bear no more; 34 years therefore an Engliſh woman bears children. At the age of 14 or 15 they are objects of our love; they are endeared by bearing us children after that time; and none, I hope, will pretend, that at 48 and 50 an Engliſhwoman is not an agreeable companion. The Arab, on the other hand, if ſhe begins to bear children at 11, ſeldom or never has a child after 20. The time, then, of her child-bearing is nine years; and four women, taken altogether, have then the term of 36. So that the Engliſh woman that bears children for 34 years has only two years leſs than the term enjoyed by the four wives whom Mahomet has allowed; and if it be granted that an Engliſh wife may bear at 50, the terms are equal. But there are other grievous differences. An Arabian girl, at 11 years old, by her youth and beauty, is the object of man's deſire: being an infant, however, in underſtanding, ſhe is not a rational companion for him. A man marries there, ſay at 20; and before he is 30, his wife, improved as a companion, ceaſes to be an object of his deſires and a mother of children: ſo that all the beſt and moſt vigorous of his days are ſpent with a woman he cannot love; with her he would be deſtined to live 40, or 45 years, without comfort to himſelf by increaſe of family, or utility to the public. The reaſons, then, againſt polygamy, which ſubſiſt in England, do not by any means ſubſiſt in Arabia; and that being the caſe, it would be unworthy of the wiſdom of God, and an unevenneſs in his ways, which we ſhall never ſee, to ſubject two nations under ſuch different circumſtances abſolutely to the ſame obſervances."

To all this argumentation, however, it may be replied, that whatever we may now ſuppoſe to be the conſtitution of nature in the warmer parts of the globe, it certainly was different at the beginning. We cannot indeed aſcertain the exact poſition of the Garden of Eden; but it is with reaſon ſuppoſed not to have been far from the ancient ſeat of Babylon. In that country, therefore, where Mr Bruce contends that *four* women are neceſſary to the comfort of one man, it pleaſed God to grant only *one* to the firſt man; and that, too, when there was more occaſion for population than ever there has been ſince, becauſe the whole earth was to be peopled from a ſingle pair. Matters were not altered at the flood; for Noah had but one wife. And this is the very argument uſed by our Saviour himſelf when ſpeaking of divorce without any ſufficient cauſe, and then marrying another woman, which is a ſpecies of polygamy.—Again, with reſpect to the alleged multiplicity of females in the eaſtern part of the world, it is by no means probable that the calculations of Mr Bruce or any other perſon can be admitted in this caſe. Hiſtory mentions no ſuch thing in any nation; and conſidering the vaſt deſtruction among the male part of the human ſpecies more than of the females by war and other accidents, we may ſafely ſay, that if *four* women children were born for every ſingle male, there would in ſuch countries be five or ſix grown up women for every man; a proportion which we may venture to affirm does not, nor ever did, exiſt anywhere in the world. That it was not ſo in former times we can only judge from the particular examples recorded in hiſtory, and theſe are but few. We read in the Greek hiſtory, indeed, of the *fifty* daughters of Danaus; but theſe were matched by as many *ſons* of another man. Job had only one wife, yet had *ſeven* ſons and but *three* daughters. Jacob had two wives, who bore *twelve* ſons, and only one daughter. Abraham had only one child by his firſt wife, and that was a ſon. By his ſecond wife Keturah he had ſix ſons; and conſidering his advanced age at the time he married her, it is by no means probable that he could have 24 daughters; nay, if, as Mr Bruce tells us, the women in the eaſtern countries bear children only for nine years, it was impoſſible ſhe could have ſo many. Gideon, who had many wives, had no fewer than ſeventy ſons by theſe wives, and even his concubine had a ſon; ſo that if all theſe women had produced according to Mr Bruce's proportion, of nearly three females to one male, he muſt have had almoſt 284 children; a better family than any of Mr Bruce's eaſtern acquaintances can probably boaſt of.

With regard to this ſubject, however, it muſt be obſerved, that the procreation of male or female children depends in ſome degree on the health and vigour of the parents. It is by no means improbable, therefore, that the eaſtern voluptuaries, whoſe conſtitutions are debilitated by their exceſſes, may have many more female than male children born to them. The women themſelves, by premature enjoyment, will alſo be inclined to produce females inſtead of males; but neither of theſe circumſtances can prove this to be an original law of nature. Something like this may be gathered from ſacred hiſtory. Gideon abovementioned, who was a hardy and active warrior, had many ſons. The ſame was the caſe with David, who led an active and laborious life; while Solomon, who was a voluptuary, had only one ſon, notwithſtanding his multitude of wives.

The moſt barefaced defence of polygamy that has appeared in modern times is by the Rev. Mr Madan, who publiſhed a treatiſe, artfully vindicating, and ſtrongly recommending it, under the title of *Thelyphthora*; or, *A treatiſe on Female Ruin, in its Cauſes, Effects, Conſequences, Prevention, and Remedy*, &c. Marriage, according to this writer, ſimply and wholly conſiſts in the act of perſonal union, or *actus coitus*. Adultery, he ſays, is never uſed in the ſacred writings but to denote the defilement of a betrothed or married woman, and to this ſenſe he reſtricts the uſe of the term; ſo that a married man, in his opinion, is no adulterer, if his commerce with the ſex be confined to ſingle women, who are under no obligations by eſpouſals or marriage to other men: but, on the other hand, the woman who ſhould dare to have even but once an intrigue with any other man beſides her huſband, (let him have as many wives as Solomon), would, *ipſo facto*, be an adultereſs, and ought, together with her gallant, to be puniſhed with immediate death. This, he boldly ſays, is the law of God: and on this foundation he limits the privilege of polygamy to the man; in ſupport of which he refers to the polygamous connections of the patriarchs and ſaints of the Old Teſtament, and infers the lawfulneſs of their practice from the bleſſings which attended it, and the laws which were inſtituted to regulate and ſuperintend it. He contends for the lawfulneſs of Chriſtians having, like the ancient Jews, more wives than one; and labours much to reconcile the genius of the evangelical diſpenſation to an arrangement of this ſort. With this view he aſſerts, that there is not one text in the New Teſtament that even hints at the criminality of a polygamous connection; and he would infer from St Paul's direction, that biſhops and deacons ſhould have but one wife, that it was lawful for laymen to have more. Chriſt, he ſays, was not the giver of a new law; but the buſineſs of marriage, polygamy, &c. had been ſettled before his appearance in the world, by an authority which could not be revoked. Beſides, this writer not only thinks polygamy lawful in a religious, but advantageous in a civil, light, and highly politic in a domeſtic view.

In defence of his notion of marriage, which, he ſays, conſiſts in the union of man and woman as one body, the effects of which in the ſight of God no outward forms or ceremonies of man's invention can add to or detract from, he grounds his principal argument on the Hebrew words made uſe of in Gen. ii. 24. to expreſs the primitive inſtitution of marriage. viz. דבק באשתו, rendered by the LXX. προσκολληθησεται προς την γυναικα αυτου, which tranſlation is adopted by the evangeliſt (Mat. xix. 5.) with the omiſſion only of the ſuperfluous prepoſition (προς) after the verb. Our tranſlation, "ſhall cleave to his wife," doth not, he ſays, convey the idea of the Hebrew, which is literally, as Montanus renders the words, "ſhall be joined or cemented *in* his woman, and they ſhall become (*i. e.* by this union) one fleſh." But on this criticiſm it is well remarked, that both the Hebrew and Greek terms mean ſimply and literally attachment or adherence; and are evidently made uſe of in the ſacred writings to expreſs the whole ſcope of conjugal fidelity and duty though he would reſtrain them to the groſſer part of it.

With reſpect to the Moſaic law, for which Mr Madan is a warm advocate, it was certainly a local and temporary inſtitution, adapted to the ends for which it was appointed, and admirably calculated, in its relation to marriage, to maintain and perpetuate the ſeparation of the Jewiſh people from the Gentiles. In attempting to depreciate the outward forms of marriage, this writer would make his readers believe, that becauſe none are explicitly deſcribed, therefore none exiſted; and conſequently that they are the ſuperfluous ordinances of human policy. But it is evident, from comparing Ruth iv. 10. 13. with Tobit vii. 13. 14. and from the caſe of Dinah, related Gen. xxxiv. that ſome forms were deemed eſſential to an honourable alliance by the patriarchs and ſaints under the Old Teſtament, excluſive of the carnal knowledge of each other's perſons. It is alſo evident in the caſe of the woman of Samaria, whoſe connection with a man not her huſband is mentioned in John iv. that ſomething beſides cohabitation is neceſſary to conſtitute marriage in the ſight of God.

Having ſtated his notion of marriage, he urges, in defence of polygamy, that, notwithſtanding the ſeventh commandment, it was allowed by God himſelf, who made laws for the regulation of it, wrought miracles in ſupport of it by making the barren women fruitful, and declared the iſſue legitimate to all intents and purpoſes. God's allowance of polygamy is argued from Exod. xxi. 10. and particularly from Deut. xxi. 15, which, he ſays, amounts to a demonſtration. This paſſage, however, at the utmoſt, only preſuppoſes that the practice might have exiſtence among ſo hard-hearted and fickle a people as the Jews; and therefore wiſely provides againſt ſome of its more unjuſt and pernicious conſequences, ſuch as tended to affect the rights and privileges of heirſhip. Laws enacted to regulate it cannot be fairly urged in proof of its lawfulneſs on the author's own hypotheſis; becauſe laws were alſo made to regulate divorce, which Mr Madan condemns as abſolutely unlawful, except in caſes of adultery. Beſides, it is more probable that the "hated wife" had been diſmiſſed by a bill of divorcement, than that ſhe was retained by her huſband: and moreover, it is not certain but that the two wives, ſo far from living with the ſame huſband at the ſame time, might be dead; for the words may be rendered thus, "if there *ſhould have been* to a man two wives, &c." The words expreſſing the original inſtitution of marriage, Gen. ii. 24. compared with Mat. xix. 4, 5, 8. afford inſuperable objections againſt Mr Madan's doctrine of polygamy.

If we appeal on this ſubject, from the authority of Scripture to the writings of the earlieſt fathers in the Chriſtian church, there is not to be found the fainteſt trace of any thing reſembling a teſtimony to the lawfulneſs of polygamy; on the contrary, many paſſages occur, in which the practice of it is ſtrongly and explicitly condemned.

Monthly Review, vol. 63. p. 338. See alſo vol. 69.

We ſhall cloſe this article with the words of an excellent anonymous writer already quoted, and to whoſe critique on Mr Madan's work we are indebted for the above remarks: "In a word, when we reflect that the primitive inſtitution of marriage limited it to one man and one woman; that this inſtitution was adhered to by Noah and his ſons, amidſt the degeneracy of the age in which they lived, and in ſpite of the examples of polygamy which the accurſed race of Cain had introduced; when we conſider how very few (comparatively ſpeaking) the examples of this practice were among the faithful; how much it brought its own puniſhment with it; and how dubious and equivocal thoſe paſſages are in which it appears to have the ſanction of divine approbation; when to theſe reflections we add another, reſpecting the limited views and temporary nature of the more ancient diſpenſations and inſtitutions of religion—how often the imperfections and even vices of the patriarchs and people of God, in old time, are recorded, without any expreſs notification of their criminality—how much is ſaid to be commanded, which our reverence for the holineſs of God and his law will only ſuffer us to ſuppoſe, were, for wiſe ends, permitted—how frequently the meſſengers of God adapted themſelves to the genius of the people to whom they were ſent, and the circumſtances of the times in which they lived:—above all, when we conſider the purity, equity, and benevolence of the Chriſtian law; the explicit declaration of our Lord, and his apoſtle St Paul, reſpecting the inſtitution of marriage its deſign and limitation;—when we reflect, too, on the teſtimony of the moſt ancient fathers, who could not poſſibly be ignorant of the general and common practice of the apoſtolic church; and, finally, when to theſe conſiderations we add thoſe which are founded on juſtice to the female ſex, and all the regulations of domeſtic economy and national policy—we muſt wholly condemn the revival of polygamy; and thus bear our honeſt teſtimony againſt the leading deſign of this dangerous and ill-adviſed publication."

We would adviſe our readers to read the whole criticiſms on Madan's book in the Monthly Review, together with their account of the ſeveral anſwers to it. The reverend author of the Thelyphthora has there met with a moſt able antagoniſt, who traces him through all his deceitful windings, and expoſes the futility and falſehood of his arguments with ſingular ability. See *Monthly Review*, vol. lxiii. p. 273, &c.; ſee alſo *Paley's Moral Philoſophy*, 4to. p. 262.

POLYGARS, are natives of Hindoſtan. They inhabit almoſt impenetrable woods, and are under the abſolute direction of their own chieſtains. In time of peace they are profeſſionally robbers, but in times of war are the guardians of the country. The general name of theſe people is *Polygar*. Their original inſtitution, for they live in diſtinct clans, is not very well underſtood. It probably took its riſe from the municipal regulations relative to the deſtruction of tygers and other ferocious beaſts. Certain tracts of woodland were indiſputedly allotted as rewards to thoſe who ſhould ſlay a certain number of thoſe animals; and thoſe lands approximating, probably laid the foundation of the ſeveral confederacies of Polygars.

"The Pollams, or woods, from which is derived the word *Polygar*, lying in profuſion through all the ſouthern parts of Hindoſtan, the ravages committed in the open countries by theſe adventurous clans, are both frequent and deſtructive. Cattle and grain are the conſtant booty of the Polygars. They not unfrequently even deſpoil travellers of their property, and ſometimes murder, if they meet with oppoſition: yet theſe very Polygars are the hands into which the aged and infirm, the wives, children, and treaſure, of both Hindoos and others are entruſted, when the circumjacent country unfortunately happens to be the ſeat of war. The protection they afford is paid for; but the price is inconſiderable, when the helpleſs ſituation of thoſe who fly to them for ſhelter is conſidered, and eſpecially when their own very peculiar character is properly attended to. The native governments of Hindoſtan are under the neceſſity of tolerating this honourable banditti. Many of them are ſo formidable as to be able to bring 15,000 and 20,000 men into the field.

"The Hindoo code of laws, in ſpeaking of robberies, hath this remarkable clauſe, 'The mode of ſhares amongſt robbers ſhall be this:—If any thief or thieves, by the command of the magiſtrate, and with his aſſiſtance, have committed depredations upon, and brought away any booty from, another province, the magiſtrate ſhall receive a ſhare of one ſixth part of the whole. If they received no command or aſſiſtance from the magiſtrate, they ſhall give the magiſtrate in that caſe one tenth part for his ſhare, and of the remainder their chief ſhall receive four ſhares; and whoſoever among them is perfect maſter of his occupation, ſhall receive three ſhares: alſo, which ever of them is remarkably ſtrong and ſtout, ſhall receive two ſhares, and the reſt ſhall receive each one ſhare.' Here, then, we ſee not only a ſanction, but even an inducement, to fraudulent practices.—Another ſingular inconſiſtency among a people who, in many periods of their hiſtory, have been proverbial for innocency of manners, and for uncommon honeſty in their conduct towards travellers and ſtrangers.

"At the firſt ſight, it would appear that the toleration of the Polygars, owing to their great numbers, and to the ſecurity of their fortreſſes, which are in general impenetrable but to Polygars; that the government licence, in this manner given to them, to live on the ſpoils of the induſtrious—might have originally occaſioned the formal diviſion, and encouragement to perſeverance, which we have juſt quoted: but the cauſe I ſhould rather ſuppoſe to lie in the nature of certain governments, than to have ariſen from any accidental circumſtance afterwards; and I am the more inclined to this opinion, from the ſituation of the northern parts of Hindoſtan, which are, and always have been, uninfeſted by theſe freebooters.

"The dominion of the Eaſt was, in former days, moſt probably divided and ſubdivided into all the various branches of the feodal ſyſtem. The veſtiges of it remain to this hour: rajahs and zemindars are nothing more than chieftains of a certain degree of conſequence in the empire. If, then, experience has ſhown, in other parts of the world, that clans have always been obſerved to commit the moſt pernicious acts of depredation and hoſtility on each other, and that the paramount lord has ſeldom been able effectually to cruſh ſo general and ſo complicated a ſcene of miſchief—may we not reaſonably venture to ſuppoſe, that the Hindoo legiſlature paſſed this ordinance for the ſuppreſſion of ſuch provincial warfare, and for the wholeſome purpoſe of drawing the people, by unalarming degrees, more immediately under the controul of the one ſovereign authority? The concluſion, I own, appears to me ſatisfactory. Moreover, Polygars cannot but be of modern growth; for the law relative to thefts is antecedent to the mention of Polygars in hiſtory." Sullivan's *Philoſophical Rhapſodies*.

POLYGLOTT, among divines and critics, chiefly denotes a Bible printed in ſeveral languages. See BIBLE and PRINTING.

POLYGLOTTUS, in ornithology. See TURDUS.

POLYGNOTUS, a famous painter of Thaſos, flouriſhed about 422 years before the Chriſtian era, and was the ſon and ſcholar of Aglaophon. He adorned one of the public porticoes of Athens with his paintings, in which he had repreſented the moſt ſtriking events of the Trojan war. The Athenians were ſo pleaſed with him, that they offered to reward his labours with whatever he pleaſed to accept; but he declined the offer; and the Amphictyonic council, which was compoſed of the repreſentatives of the principal cities of Greece, ordered that Polygnotus ſhould be maintained at the public expence wherever he went.

Of the talents of Polygnotus much honourable mention is made by many of the beſt authors of antiquity, as Ariſtotle and Plutarch, Dionyſius Halicarnaſſenſis, &c. Pauſanias ſpeaks of his pictures of the events of the Trojan war, and, in his Tenth Book, introduces a very long deſcription of other pictures by the ſame artiſt, painted alſo from Homer in the temple at Delphos. The paſſage, however, gives but a confuſed and imperfect idea of the painter's performance. How much the art is indebted to this ancient maſter, what grace and ſoftneſs he gave to the human countenance, what embelliſhments he added to the female figure and dreſs, are much more happily deſcribed by Pliny. "Primus mulieres lucida veſte pinxit, capita earum mitris verſicoloribus operuit, plurimumque picturæ primus contulit: ſiquidem inſtituit os adaperire, dentes oſtendere, vultum ab antiquo rigore variare."—The ſame author likewiſe bears honourable teſtimony to the liberal ſpirit of this great artiſt, who refuſed any reward for his ingenious labours in the portico.——"Porticum gratuito, cum partem ejus Mycon mercede pingeret." Plin. *lib*. 35. *cap*. 8.

POLYGON, in geometry, a figure with many ſides, or whoſe perimeter conſiſts of more than four ſides at leaſt; ſuch are the pentagon, hexagon, heptagon, &c.

POLYGONUM, KNOT-GRASS: A genus of the trigynia order, belonging to the octandria claſs of plants; and in the natural method ranking under the 12th order, *Holoraceæ*. There is no calyx; the corolla is quinquepartite, and calycine, or ſerving inſtead of a calyx; there is one angulated ſeed. There are 27 ſpecies; but the moſt remarkable are, 1. The biſtorta, biſtort, or greater ſnakeweed, hath a thick oblique intorted root, blackiſh without, and red within; a ſimple, round, ſlender ſtem, near two feet high; oval leaves, having decurrent foot-ſtalks, and the ſtalk terminated by thick ſhort ſpikes of whitiſh-red flowers. 2. The viviparum, or ſmaller biſtort, hath a thickiſh root, a ſimple ſlender ſtem half a foot high, ſpear-ſhaped leaves, and the ſtalks and branches terminated by long ſpikes of whitiſh-red flowers. Both theſe perennials flower in May and June, ſucceeded by ripe ſeeds in Auguſt. They grow wild in England, &c. the firſt in moiſt, the other in mountainous, ſituations. 3. Oriental polygonum, commonly called *perſicaria*, hath fibrous roots; an upright, robuſt, ſtrong, jointed ſtem, riſing eight or ten feet high, dividing at top into ſeveral branches; very large oval-lanceolate alternate leaves, on broad footſtalks half ſurrounding the ſtem; and all the branches terminated by long, ſlender, hanging ſpikes of reddiſh-purple heptandrous and digynious flowers, from July till October. 4. Fagopyrum, buckwheat, or brank, riſes with an upright, ſmooth, branchy ſtem, from about a foot and a half to a yard high, heart-ſhaped ſagittated leaves, and the branches terminated by cluſters of whitiſh flowers, ſucceeded by large angular ſeeds; excellent for feeding pigeons and moſt ſorts of poultry.

All theſe plants are hardy, and ſucceed in almoſt any ſoil and ſituation; the two firſt are perennial in root; and the third and fourth are annual, wholly decay at the end of ſummer, or early in winter. The firſt two ſorts are retained in ſome curious gardens for variety; but their chief merit is for medical purpoſes; they are powerful aſtringents, and are uſed both internally and externally; eſteemed very efficacious in hæmorrhagies and other fluxes; and good to heal ſore mouths. The third ſort, Oriental polygonum, or perſicaria, is a moſt elegant annual for the embelliſhment of pleaſure-ground; aſſuming a majeſtic tree-like growth by its erect luxuriant ſtem, and branchy head; which being garniſhed with noble large foliage, and numerous pendulous ſpikes of flowers, in conſtant ſucceſſion three or four months, exhibits a very ornamental appearance from June or July until October, and is ſo eaſy of culture, that from its ſcattered ſeeds in autumn, young plants riſe ſpontaneouſly in abundance the enſuing ſpring, and ſhoot up ſo rapidly as to attain ſix or eight feet in height by July, when they generally begin flowering, and continue till attacked by the froſt, when they totally periſh; ſo that a freſh ſupply muſt be raiſed from ſeed annually. The fourth ſort (buck-wheat) is a ſort of corn, and is frequently cultivated both by way of fodder, cutting its ſtalks while young and green to feed cattle, and for its grain to feed pigeons, poultry, hogs, &c. It flouriſhes in any ſoil and ſituation, but generally thrives beſt in a light dry earth; and the drieſt ſeaſons ſeldom retard its growth. The firſt and ſecond ſorts are eaſily propagated in plenty, by parting the roots in autumn. The third ſort, Oriental polygonum, being annual is always propagated from ſeed annually, either in the full ground, or by means of hot-beds.

Uſes. The root of a kind of biſtort, according to Gmelin, is uſed in Siberia for ordinary food. This ſpecies is by Haller called *biſtorta foliis ad oram nervoſis*, and by ſome other botaniſts *biſtorta montana minor*. The natives call it *mouka;* and ſo indolent are they, that, to ſave themſelves the trouble of digging it out of the earth, they go in ſpring and pillage the holes of the mountain rats, which they find filled with theſe roots. In Britain, biſtort is uſed as a medicine. All the parts of biſtort, have a rough auſtere taſte, particularly the root, which is one of the ſtrongeſt of the vegetable aſtringents. It is employed in all kinds of immoderate hæmorrhagies and other fluxes, both internally and externally, where aſtringency is the only indication. It is certainly a very powerful ſtyptic, and is to be looked on ſimply as ſuch; the ſudorific, antipeſtilential, and other like virtues aſcribed to it, it has no other claim to than in conſequence of its aſtringency, and of the antiſeptic power which it has in common with other vegetable ſtyptics. The largeſt doſe of the root in powder is a ſingle dram.

POLYGRAPHY, Polygraphia, or *Polygraphice*, the art of writing in various unuſual manners or ciphers; as alſo of deciphering the ſame. The word is formed from the Greek, *πολυ multum*, and *γραφη ſcriptura*, "writing."

The ancients ſeem to have been very little acquainted with this art; nor is there any mark of their having gone beyond the Lacedemonian ſcytala. Trithemius, Porta, Vigenere, and father Niceron, have written on the ſubject of polygraphy or ciphers. See Cipher.

POLYHYMNIA, in the pagan mythology, one of the nine muſes, thus named from the Greek words Πολυς "much," and ὑμνος "ſong." She preſided over hiſtory, or rather rhetoric; and is repreſented with a crown of pearls and a white robe; her right hand in action as if haranguing, and holding in her left a caduceus or ſceptre to ſhow her power.

POLYHEDRON, in geometry, denotes a body or ſolid comprehended under many ſides or planes.

Polyhedron, in optics, is a multiplying glaſs or lens, conſiſting of ſeveral plane ſurfaces diſpoſed into a convex form. See Optics, n° 256.

POLYMATHY, denotes the knowledge of many arts and ſciences. The word is derived from the Greek, Πολυ *multum*, and *μαθανω*, *diſco*.

POLYMNESTOR, was a king of the Thracian Cherſoneſus. He married Ilione, Priam's eldeſt daughter; and for the ſake of the treaſure with which he was entruſted by Priam during the ſiege of Troy, he murdered Polydorus, (ſee Polydorus). The fleet in which the victorious Greeks returned, together with their Trojan captives, among whom was Hecuba, ſtopped on the coaſts of Thrace, where one of the female captives diſcovered on the ſhore the body of Polydorus, whom Polymneſtor had thrown into the ſea. The dreadful intelligence was immediately communicated to Hecuba his mother, who recollecting the frightful dreams ſhe had the preceding night, did not doubt but Polymneſtor was the cruel aſſaſſin. Reſolved to revenge her ſon's death, ſhe immediately called out Polymneſtor, as if to impart to him ſomething of importance. He was drawn into the ſnare; and no ſooner was he introduced into the apartment of the Trojan princeſs, than the female captives ruſhing upon him, put out his eyes with their pins, while Hecuba murdered his two children, who had accompanied him. Euripides informs us, that the Greeks condemned Polymneſtor to be baniſhed into a diſtant iſland for his perfidy. Hyginus, however, relates the whole differently, and tells us, that when Polydorus was ſent to Thrace, Ilione his ſiſter took him inſtead of her ſon Deiphilus, who was of the ſame age, being fearful of her huſband's cruelty. The monarch, unacquainted with the impoſition, looked upon Polydorus as his own ſon, and treated Deiphilus as her brother. After the deſtruction of Troy, the conquerors wiſhed the houſe and family of Priam to be extirpated, and therefore offered Electra the daughter of Agamemnon to Polymneſtor, if he would deſtroy Ilione and Polydorus. He accepted the offer, and immediately diſpatched his own ſon Deiphilus, whom he took for Polydorus. Polydorus, who paſſed as the ſon of Polymneſtor, conſulted the oracle after the murder of Deiphilus, and being informed that his father was dead, his mother a captive in the hands of the Greeks, and his country in ruins, he communicated the anſwer to Ilione, whom he had always regarded as his mother. She told him the meaſures ſhe had purſued to ſave his life, upon which he avenged the perfidy of Polymneſtor by putting out his eyes.

POLYMNIA, in botany: A genus of the polygamia neceſſaria order, belonging to the ſyngeneſia claſs of plants; and in the natural method ranking under the 49th order, *Compoſitæ*. The receptacle is paleaceous; there is no pappus; the exterior calyx is tetraphyllous, or pentaphyllous; the interior decaphyllous, and compoſed of concave leafets.

POLYNICES, the ſon of Œdipus by his mother Jocaſta. See Jocasta, Œdipus, and Eteocles.

POLYPE. See Polypus.

POLYPETALOUS, among botaniſts, an epithet applied to ſuch flowers as conſiſt of ſeveral petals or flower-leaves.

POLYPHEMUS (fab hiſt.), a celebrated Cyclops, and king of all the Cyclops in Sicily, was the ſon of Neptune and Thooſa the daughter of Phorcys. He is ſaid to have been a monſter of great ſtrength, very tall, and with one eye in the middle of the forehead. He eat human fleſh, and kept his flocks on the coaſt of Sicily, when Ulyſſes, at his return from the Trojan war, was driven there. Ulyſſes, together with 12 of his companions, viſited the coaſt, and with them was ſeized by the Cyclops, who confined them in his cave, and daily devoured two of them. Ulyſſes would have ſhared the fate of the reſt, had he not intoxicated the Cyclops, and put out his eye with a firebrand when he was aſleep. Polyphemus was awakened by the ſudden pain, and ſtopped the entrance of his cave; but Ulyſſes eſcaped, by creeping between the legs of the rams of the Cyclops, as they were led out to feed on the mountains. Polyphemus became enamoured of Galatæa; but his addreſſes were diſregarded, and the nymph ſhunned his preſence. The Cyclops was ſtill more earneſt; and when he ſaw Galatæa ſurrender herſelf to the pleaſures of Acis, he cruſhed his rival with a piece of a broken rock.

POLYPODIUM, in botany; a genus of the order of filices, belonging to the cryptogamia claſs of plants. The fructifications are in roundiſh points, ſcattered over the inferior diſc of the frons or leaf.—There are 65 ſpecies, of which the moſt remarkable is the filix mas, or common male fern. This grows in great plenty throughout Britain in woods and ſtony uncultivated ſoils. The greateſt part of the root lies horizontally, and has a great number of appendages placed cloſe to each other in a vertical direction, while a number of ſmall fibres ſtrike downwards. The leaves are a cubit high, and grow in circular tufts. They are at firſt alternately pinnate, the pinnæ increaſing in ſize from the baſe towards the middle, and afterwards gradually decreaſing upwards to the ſummit of the leaf. Theſe pinnæ are again pinnatifid, or ſubdivided almoſt to the nerve into obtuſe parallel lobes, crenated on the edges. The ſtalks are covered with brown filmy ſcales. The fructifications are kidney-ſhaped, and covered with a permanent ſcaly ſhield or involucrum. The capſules are of a pale brown, ſurrounded with a ſaffron-coloured elaſtic ring.

This fern has nearly the ſame qualities, and is uſed for moſt of the ſame intentions, as the pteris aquilina. They are both burnt together for the ſake of their aſhes, which are purchaſed by the ſoap and glaſs-makers. In the iſland of Jura are exported annually 150 l. worth of theſe aſhes.

Gunner relates, in his *Flor. Noveg.* that the young curled leaves, at their firſt appearance out of the ground, are by ſome boiled and eaten like aſparagus; and that the poorer Norwegians cut off thoſe ſucculent laminæ, like the nails of the finger at the crown of the root, which are the baſes of the future ſtalks, and brew them into beer, adding thereto a third portion of malt, and in times of great ſcarcity mix the ſame in their bread. The ſame author adds, that this fern cut green, and dried in the open air, affords not only an excellent litter for cattle, but, if infuſed in hot water, becomes no contemptible fodder to goats, ſheep, and other cattle, which will readily eat and ſometimes grow fat upon it: a circumſtance well worth the attention of the inhabitants of the Highlands and Hebrides, as great numbers of their cattle, in hard winters, frequently periſh for want of food.

But the anthelmintic quality of the root of the male fern is that for which it is chiefly to be valued, and of which an account is given under the article MEDICINE, p. 343. col. 2.

The polypodium oreopteris is only remarkable becauſe it has been confounded by moſt of the Engliſh botaniſts with the ſpecies which we have now deſcribed, and the polypodium thelypteris. It has a large ſcaly root, wrapped and tied together with ſmall ſtrong fibres, not to be ſeparated without difficulty.—The fructifications are on the margins both when young and old, and never run into one another: the lobes are oval and plain. It is four times as large as the thelypteris, and grows in dry woods, moors or hills, and very ſeldom near water; all which characters are widely different from thoſe of the ſpecies with which it has been confounded. It is to be found both in England and Scotland, in the latter place very plentifully. See *Linnæan Tranſactions*, vol. 1. p. 181.

POLYPREMUM, in botany: A genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 22d order, *Caryophillei*. The calyx is tetraphyllous; the corolla quadrifid and rotaceous, with its lobes obcordate; the capſule compreſſed, emarginated, and bilocular.

POLYPUS, a ſpecies of freſh-water inſects, belonging to the genus of hydra, of the order of zoophytes, and claſs of vermes. (See ANIMALCULE, nº 24, &c.) The name of *hydra* was given them by Linnæus on account of the property they have of reproducing themſelves when cut in pieces, every part ſoon becoming a perfect animal. Dr Hill called them *biota*, on account of the ſtrong principle of life with which every part of them is endowed.

Theſe animals were firſt diſcovered by Leeuwenhoek, who gave ſome account of them in the Philoſophical Tranſactions for 1703, but their wonderful properties were not thoroughly known till the year 1740, when Mr Trembley began to inveſtigate them. Previous to his diſcoveries, indeed, Leibnitz and Boerhaave, by reaſonings *à priori*, had concluded that animals might be found which would propagate by ſlips like plants; and their conjectures were ſoon verified by the obſervations of the gentlemen above-mentioned. At firſt, however, Mr Trembley was uncertain whether he ſhould reckon theſe creatures animals or plants; and while thus uncertain, he wrote a letter on the ſubject to Mr Bonnet in January 1741; but in March the ſame year he had ſatisfied himſelf that they were real animals. The ſurpriſe of Mr Trembley, and of others, on diſcovering the true nature of theſe animals, was very great. When Mr Reaumur ſaw for the firſt time two polypes formed from one which he had divided into two parts, he could hardly believe his own eyes; and even after having repeated the operation an hundred times, he ſaid that the ſight was by no means familiar to him. On the 18th of July 1741, M. Buffon wrote to Martin Folkes, Eſq; preſident of the Royal Society, acquainting him with "the diſcovery of a ſmall inſect called a *polypus*, which is found about the common duck-weed; and which, being cut in two, puts forth from the upper part a tail, and from the lower end a head, ſo as to become two animals inſtead of one. If it be cut into three parts, the middlemoſt alſo puts out from one end a head, and from the other a tail, ſo as to become three diſtinct animals, all living like the firſt, and performing the various offices of their ſpecies."

ſpecies."—In September the ſame year, a letter was communicated from C. Bentink, Eſq; at the Hague, deſcribing the inſects diſcovered by Mr Trembley, adding, that he himſelf had ſeen them; and in November that year, a letter was read before the Society from Gronovius, at Leyden, giving an account of a water-inſect, which, ſays he, if cut into five or ſix pieces, in a few hours there will be as many animals exactly ſimilar to their parent. Theſe accounts, however, were all deemed ſo extraordinary, that they were not credited, until profeſſors Albinus and Muſchenbroeck provided themſelves with them, and found every thing related concerning them to be exactly true. In March 1742, Mr Folkes gave an account of them to the Royal Society, from ſome obſervations made on ſeveral polypes which Mr Trembley had ſent from Holland. They were ſoon after found in England, and the obſervations made upon them were publiſhed by ſeveral perſons; ſo that no doubt remained concerning the reality of what had been related concerning them.

The general character of the polype is, that it fixes itſelf by its baſe; is gelatinous, linear, naked, contractile; and can change its place. The mouth, which is placed at one end, is ſurrounded by hair-like feelers. The young ones grow out from its ſides; but in autumn it produces eggs from its ſides. There are ſix varietes.

1. The *viridis*, or green polype, has commonly ten ſhort arms.
2. The *fuſca* has frequently eight arms ſeveral times longer than the body.
3. The *griſea* is of a yellowiſh colour, ſmall towards the bottom, and has long arms, generally about ſeven in number.
4. The *pallens* has generally about ſix arms of a moderate length.
5. The *hydatula* has a veſicular body, and four obſolete arms. It is found in the abdomen of ſheep, ſwine, &c.
6. The *ſtentorea* has been called the *tunnel-ſhaped*, and has a mouth ſurrounded with a row of hairs.
7. The *ſocialis* is bearded, thick, and wrinkled.

The three firſt ſpecies are thoſe on which the greateſt number of experiments have been made; and their ſhapes are ſo various, that it is by no means eaſy to deſcribe them. They are generally found in ditches. Whoever has carefully examined theſe when the ſun is very powerful, will find many little tranſparent lumps of the appearance of a jelly, and ſize of a pea, and flatted upon one ſide. The ſame kind of ſubſtances are likewiſe to be met with on the under ſide of the leaves of plants which grow in ſuch places. Theſe are the polypes in a quieſcent ſtate, and apparently inanimate. They are generally fixed by one end to ſome ſolid ſubſtance, with a large opening, which is the mouth, at the other; having ſeveral arms fixed round it, projecting as rays from the centre. They are ſlender, pellucid, and formed of a tender ſubſtance like the horns of a ſnail, and capable of contracting themſelves into a very ſmall compaſs, or of extending to a conſiderable length. The arms are capable of the ſame contraction and expanſion as the body; and with theſe they lay hold of minute worms and other inſects, bringing them to the mouth and ſwallowing them; the indigeſtible parts are again thrown out by the mouth.

The green polype was that firſt diſcovered by Mr Trembley; and the firſt appearances of ſpontaneous motion were perceived in its arms, which it can contract, extend, and twiſt about in various directions. On the firſt appearance of danger they contract to ſuch a degree that they appear little bigger than a grain of ſand, of a fine green colour, the arms diſappearing entirely. Soon after he found the griſea, and afterwards the fuſca.

The bodies of the viridis and griſea diminiſh almoſt inſenſibly from the anterior to the poſterior extremity; but the fuſca is for the moſt part of an equal ſize for two-thirds of its length from the anterior to the poſterior extremity, from which it becomes abruptly ſmaller, and then continues of a regular ſize to the end. Theſe three kinds have at leaſt ſix, and at moſt 12 or 13 arms, though ſometimes the griſea is met with having 18 arms. They can contract themſelves till their bodies do not exceed one-tenth of an inch in length, and they can ſtop at any intermediate degree of contraction or extenſion. They are of various ſizes, from half an inch to an inch and an half long; their arms are ſeldom longer than their bodies, though ſome have them an inch, and ſome even eight inches, long. The thickneſs of their bodies decreaſes as they extend themſelves, and *vice verſa;* and they may be made to contract themſelves either by agitating the water in which they are contained, or by touching the animals themſelves. When taken out of the water, they all contract ſo much that they appear only like a little lump of jelly. The arms have the ſame power of contraction or expanſion that the body has; and they can contract or expand one arm, or any number of arms, independent of the reſt; and they can likewiſe bend their bodies or arms in all poſſible directions. They can alſo dilate or contract their bodies in various places, and ſometimes appear thick ſet with folds, which, when careleſsly viewed, appear like rings. Their progreſſive motion is performed by that power which they have of contracting and dilating their bodies. When about to move, they bend down their head and arms, lay hold by means of them on ſome other ſubſtance to which they deſign to faſten themſelves; then they looſen their tail, and draw it towards the head; then either fix it in that place, or ſtretching forward their head as before, repeat the ſame operation. They aſcend or deſcend at pleaſure in this manner upon aquatic plants, or upon the ſides of the veſſel in which they are kept; they ſometimes hang by the tail from the ſurface of the water, or ſometimes by one of the arms; and they can walk with eaſe upon the ſurface of the water. On examining the tail with a microſcope, a ſmall part of it will be found to be dry above the ſurface of the water, and as it were in a little concave ſpace, of which the tail forms the bottom; ſo that it ſeems to be ſuſpended on the ſurface of the water on the ſame principle that a ſmall pin or needle is made to ſwim. When a polype, therefore, means to paſs from the ſides of the glaſs to the ſurface of the water, it has only to put that part out of the water by which it is to be ſupported, and to give it time to dry, which it always does upon theſe occaſions; and they attach themſelves ſo firmly by the tail to aquatic plants, ſtones, &c. that they cannot be eaſily diſengaged: they often further ſtrengthen theſe attachments by means of one or two of their arms, which ſerve as a kind of anchors for fixing them to the adjacent ſubſtances.

The ſtomach of the polype is a kind of bag or gut into which the mouth opens, and goes from the head to the tail. This, in a ſtrong light, is viſible to the naked eye, eſpecially if the animal be placed between the eye and a candle; for theſe animals are quite tranſparent whatever their colour may be. The ſtomach, however, appears to more advantage through a powerful magnifier. Mr Trembley, by cutting one of theſe animals tranſverſely into three parts, ſatiſfied himſelf that they were perforated throughout. Each piece immediately contracted itſelf, and the perforation was very viſible through a microſcope. The ſkin which incloſes the ſtomach is that of the polype itſelf; ſo that the whole animal, properly ſpeaking, conſiſts only of one ſkin, in the form of a tube, and open at both ends. No veſſels of any kind are to be diſtinguiſhed.

The mouth is ſituated at the anterior end in the middle between the ſhooting forth of the arms, and aſſumes different appearances according to circumſtances; being ſometimes lengthened out in the form of a nipple, at others appearing truncated; ſometimes the aperture is quite cloſed, at others there is a hollow; though at all times a ſmall aperture may be diſcovered by a powerful magnifier.

The ſkin of a polype, when examined with a microſcope, appears like ſhagreen, or as if covered with little grains, more or leſs ſeparated from each other, according to the degree of contraction of the body. If the lips of a polype be cut tranſverſely, and placed ſo that the cut part of the ſkin may lie directly before the microſcope, the ſkin throughout its whole thickneſs will be found to conſiſt of an infinite number of grains, and the interior part is found to be more ſhagreened than the exterior one; but they are not ſtrongly united to each other, and may be ſeparated without much trouble. They even ſeparate of themſelves, though in no great numbers, in the moſt healthy animals of this kind; for where they are obſerved to ſeparate in large quantities, it is a ſymptom of a very dangerous diſorder. In the progreſs of this diſorder, the ſurface of the polype becomes gradually more and more rough and unequal, and no longer well defined or terminated as before. The grains fall off on all ſides; the body and arms contract and dilate, and aſſume a white ſhining colour; and at laſt the whole diſſolves into an heap of grains, which is more particularly obſerved in the green polype. By a careful examination we find, that the ſkin of the polype is entirely compoſed of grains, cemented by means of a kind of gummy ſubſtance; but it is to the grains entirely that the polype owes its colour. The ſtructure of the arms is analogous to that of the body; and they appear ſhagreened when examined by the microſcope, whether they be in a ſtate of contraction or extenſion; but if very much contracted, they appear more ſhagreened than the body, though almoſt quite ſmooth when in their utmoſt ſtate of extenſion. In the green polype the appearance of the arm is continually varying; and theſe variations are more ſenſible towards the extremity of the arm than at its origin, but more ſcattered in the parts further on. The extremity is often terminated by a knob, the hairs of which cannot be obſerved without a very powerful magnifier. They have a remarkable inclination of turning towards the light; ſo that if that part of the glaſs on which they are be turned from the light, they will quickly remove to the other.

That ſpecies named the *fuſca* has the longeſt arms, and makes uſe of the moſt curious manœuvers to ſeize its prey. They are beſt viewed in a glaſs ſeven or eight inches deep, when their arms commonly hang down to the bottom. When this, or any other kind, is hungry, it ſpreads its arms in a kind of circle to a conſiderable extent, incloſing in this, as in a net, every inſect which has the misfortune to come within the circumference. (See Animalcule, n° 27.). While the animal is contracted by ſeizing its prey, the arms are obſerved to ſwell like the muſcles of the human body when in action. Though no appearance of eyes can be obſerved in the polype, they certainly have ſome knowledge of the approach of their prey, and ſhow the greateſt attention to it as ſoon as it comes near them. It ſeizes a worm the moment it is touched by one of the arms; and in conveying it to the mouth, it frequently twiſts the arm into a ſpiral like a corkſcrew; by which means the inſect is brought to the mouth in a much ſhorter time than otherwiſe it would be; and ſo ſoon are the inſects on which the polypes feed killed by them, that M. Fontana thinks they muſt contain the moſt powerful kind of poiſon; for the lips ſcarce touch the animal when it expires, though there cannot be any wound perceived on it when dead. The worm, when ſwallowed, appears ſometimes ſingle, ſometimes double, according to circumſtances. When full, the polype contracts itſelf, hangs down as in a kind of ſtupor, but extends again in proportion as the food is digeſted and the excrementitious part is diſcharged. The bodies of the inſects, when ſwallowed, are firſt macerated in the ſtomach, then reduced into fragments, and driven backward and forward from one end of the ſtomach to the other, and even into the arms, however fine they may be; whence it appears that the arms, as well as the other parts of this remarkable creature, are a kind of hollow guts or ſtomachs. In order to obſerve this motion, it is beſt to feed the polypes with ſuch food as will give a lively colour; ſuch, for inſtance, as thoſe worms which are furniſhed with a red juice. Some bits of a ſmall black ſnail being given to a polype, the ſubſtance of the ſkin was ſoon diſſolved into a pulp conſiſting of ſmall black fragments; and on examining the polype with a microſcope, it was found that the particles were driven about in the ſtomach, and that they paſſed into the arms, from thence back into the ſtomach, then to the tail; from whence they paſſed again into the arms, and ſo on. The grains of which the body of the polype conſiſt take their colour from the food with which it is nouriſhed, and become red or black as the food happens to afford the one colour or the other. They are likewiſe more or leſs tinged with theſe colours in proportion to the ſtrength of the nutritive juices; and it is obſervable that they loſe their colour if fed with aliments of a colour different from themſelves. They feed on moſt inſects found in freſh water; and will alſo be ſupported with worms, the larvæ of gnats, &c. and even with ſnails, large aquatic inſects, and fiſh or fleſh, if cut into ſmall bits. Sometimes two polypes lay hold of the ſame worm, and each begins to ſwallow its own end till their mouths meet and the worm breaks. But ſhould this happen not to be the caſe, the one polype will ſometimes devour the other along with its portion. It appears, however, that the ſtomach of one polype is not fitted for diſſolving the ſubſtance of another; for the one which is ſwallowed always gets clear again after being impriſoned for an hour or two.

The manner in which the polypes generate is moſt perceptible in the griſea and fuſca, as being conſiderably larger than the viridis. If we examine one of them in ſummer, when the animals are moſt active, and prepared for propagation, ſome ſmall tubercles will be found proceeding from its ſides, which conſtantly increaſe in bulk, until at laſt in two or three days they aſſume the figure of ſmall polypes. When they firſt begin to ſhoot, the excreſſence becomes pointed, aſſuming a conical figure, and deeper colour than the reſt of the body. In a ſhort time it becomes truncated, and then cylindrical, after which the arms begin to ſhoot from the anterior end. The tail adheres to the body of the parent-animal, but gradually grows ſmaller, until at laſt it adheres only by a point, and is then ready to be ſeparated. When this is the caſe, both the mother and young ones fix themſelves to the ſides of the glaſs, and are ſeparated from each other by a ſudden jerk. The time requiſite for the formation of the young ones is very different, according to the warmth of the weather and the nature of the food eaten by the mother. Sometimes they are fully formed, and ready to drop off, in 24 hours; in other caſes, when the weather is cold, 15 days have been requiſite for bringing them to perfection.

It is remarkable, that there is a reciprocal communication of food betwixt the young and old before they be ſeparated. The young ones, as ſoon as they are furniſhed with arms, catch prey for themſelves, and communicate the digeſted food to the old ones, who on the other hand do the ſame to the young ones. This was fully verified by the following experiment: One of the large polypes of the *fuſca* kind being placed on a ſlip of paper in a little water, the middle of the body of a young one growing out from it was cut open; when the ſuperior part of that end which remained fixed to the parent was found to be open alſo. By cutting over the parent polype on each ſide of the ſhoot, a ſhort cylinder was obtained, open at both ends; which being viewed through a microſcope, the light was obſerved to come through the young one into the ſtomach of the old one. On cutting open the cylindrical portion lengthwiſe, not only the hole of communication was obſerved, but one might ſee through the end of the young one alſo. On changing the ſituation of the two pieces, the light was ſeen through the hole of communication.

This may be ſeen between the parent polype and its young ones after feeding them; for, after the parents have eaten, the bodies of the young ones ſwell as if they themſelves had been eating.

The polypes produce young ones indiſcriminately from all parts of their bodies, and five or ſix young ones have frequently been produced at once; nay, Mr Trembley has obſerved nine or ten produced at the ſame time.

Nothing like copulation among theſe creatures was ever obſerved by Mr Trembley, though for two years he had thouſands of them under his inſpection. To be more certain on this ſubject, he took two young ones the moment they came from their parent, and placed them in ſeparate glaſſes. Both of them multiplied, not only themſelves, but alſo their offspring, which were ſeparated and watched in the ſame manner to the ſeventh generation; they have even the ſame power of generation while adhering to their parent. In this ſtate the parent, with its children and grandchildren, exhibits a ſingular appearance, looking like a ſhrub thick ſet with branches. Thus ſeveral generations ſometimes are attached to one another, and all of them to one parent. Mr Adams gives a figure of one polype with *nineteen* young ones hanging at it; the whole group being about an inch broad, and an inch and an half in length; the old polype eat about twelve monoculi per day, and the young ones about 20 among them.

When a polype is cut tranſverſely or longitudinally into two or three parts, each part in a ſhort time becomes a perfect animal; and ſo great is this prolific power, that a new animal will be produced even from a ſmall portion of the ſkin of the old one. If the young ones be mutilated while they grow upon the parent, the parts ſo cut off will be reproduced, and the ſame property belongs to the parent. A truncated portion will ſend forth young ones before it has acquired a new head and tail of its own, and ſometimes the head of a young one ſupplies the place of that which ſhould have grown out of the old one. If we ſlit a polype longitudinally through the head to the middle of the body, we ſhall have one formed with two heads; and by ſlitting theſe again in the ſame manner we may form one with as many heads as we pleaſe.

A ſtill more ſurpriſing property of theſe animals is, that they may be grafted together. If the truncated portions of a polype be placed end to end, and gently puſhed together, they will unite into a ſingle one. The two portions are firſt joined together by a ſlender neck, which gradually fills up and diſappears, the food paſſing from the one part into the other; and thus we may form polypes not only from portions of the ſame, but of different animals; we may fix the head of one to the body of another, and the compound animal will grow, eat, and multiply, as if it had never been divided. By puſhing the body of one into the mouth of another, ſo far that their heads may be brought into contact, and kept there for ſome time, they will at laſt unite into one animal, only having double the number of arms which it would otherwiſe have had. The *hydra fuſca* may be turned inſide out like a glove, at the ſame time that it continues to live and act as before. The lining of the ſtomach now forms the outer ſkin, and the former epidermis conſtitutes the lining of the ſtomach. If previous to this operation the polype have young ones attached to it, ſuch as are but newly beginning to vegetate turn themſelves inſide out, while the larger ones continue to increaſe in ſize till they reach beyond the mouth of the parent, and are then ſeparated in the uſual manner from the body. When thus turned the polype combines itſelf in many different ways. The fore part frequently cloſes and becomes a ſupernumerary tail. The animal, which was at firſt ſtraight, now bends itſelf, ſo that the two tails reſemble the legs of a pair of compaſſes, which it can open and ſhut. The old mouth is placed as it were at the joint of the compaſſes, but loſes its power of action; to ſupply which, a new one is formed in its neighbourhood; and in a little time there is a new ſpecies of hydra formed with ſeveral mouths.

The ſides of a polype, which has been cut through in a longitudinal direction, begin to roll themſelves up, commonly from one of the extremities, with the outſide of the ſkin inwards; but in a little time they unroll themſelves, and the two cut edges join together, ſometimes beginning at one extremity, and ſometimes approaching throughout their whole length. As ſoon as the edges join, they unite ſo cloſely that no ſcar can be perceived. If a polype be partly turned back, the open part cloſes, and new mouths are formed in different places. Every portion of a polype is capable of devouring inſects almoſt as ſoon as it is cut off: and the voracity of the whole genus is aſtoniſhing; for Mr Adams obſerves, that moſt of the inſects on which they feed bear the ſame proportion to the mouth of a polype that an apple of the ſize of a man's head bears to his mouth.

The *hydra pallens* is very rarely met with, and is deſcribed only by M. Roeſel. It is of a pale yellow colour, growing gradually ſmaller from the bottom; the tail is round or knobbed; the arms are about the length of the body, of a white colour, generally ſeven in number, and are apparently compoſed of a chain of globules. The young are brought forth from all parts of its body.

The *hydratula* is mentioned by many medical writers. Dr Tyſon, in diſſecting an antelope, found ſeveral hydatides or films, about the ſize of a pigeon's egg, filled with water, and of an oval form, faſtened to the omentum; and ſome in the pelvis between the bladder of urine and rectum. He ſuſpected them to be animals for the following reaſons: 1. Becauſe they were included in a membrane like a matrix, ſo looſely, that by opening it with the finger or a knife, the internal bladder, containing the ſerum or lympha, ſeemed nowhere to have any connection with it, but would very readily drop out, ſtill retaining its liquor without ſpilling any. 2. This internal bladder had a neck or white body, more opaque than the reſt, and protuberant from it, with an orifice at its extremity; by which, as with a mouth, it exhauſted the ſerum from the external membrane, and ſo ſupplied its bladder or ſtomach. 3. On bringing this neck near the candle, it moved and ſhortened itſelf. It is found in the abdomen of ſheep, ſwine, mice, &c. lying between the peritoneum and the inteſtines.

The *ſtentorea*, or funnel-like polype, is of three colours, green, blue, and white; but the laſt is the moſt common. They do not form cluſters, but adhere ſingly by the tail to whatever comes in their way: the anterior end is wider than the poſterior; and, being round, gives the animal ſomewhat of a funnel form, though the circle is interrupted by a kind of ſlit or gap. The edge of this gap is ſurrounded with a great number of little fimbrillæ, which by their motions excite a current of water, that forces into the mouth of the animal the ſmall bodies that come within its reach. Mr Trembley ſays, that he has often ſeen a great number of animalcules fall into the mouths of theſe creatures; ſome of which were let out again at an opening which he could not deſcribe. They can faſhion their mouths into ſeveral different forms; and they multiply by dividing neither tranſverſely nor longitudinally, but diagonally.

The *ſocialis* is deſcribed by Muller under the title of *vorticella*. They are found in cluſters; and when viewed by a microſcope, appear like a circle ſurrounded with crowns or ciliated heads, tied by ſmall thin tails to a common centre, from whence they advance towards the circumference, and then turn like a wheel, occaſioning a vortex which brings along with it the food proper for them.

The *anaſtatica*, or cluſtering polypes, form a group reſembling a cluſter, or rather an open flower, ſupported by a ſtem, which is fixed by its lower extremity to ſome of the aquatic plants or extraneous bodies that are found in the water; the upper extremity is formed into eight or nine lateral branches, perfectly ſimilar to each other, which have alſo ſubordinate branches, whoſe collective form much reſembles that of a leaf. Every one of theſe aſſemblages is compoſed of one principal branch or nerve, which makes the main ſtem of the cluſter an angle ſomewhat larger than a right one: the ſmaller lateral branches proceed from both ſides of this nerve, and theſe are ſhorter the nearer their origin is to the principal branch. There is a polype at the extremity, and others on both ſides of the lateral twigs, but at different diſtances from their extremities. They are all exceedingly ſmall, and bell-ſhaped, with a quick motion about the mouth, though it is impoſſible to diſcern the cauſe of it. See ANIMALCULE, n° 24, 26, PULEX, and VORTICELLA.

The ſeveral ſtrange properties recorded of this animal, though very ſurpriſing, are, however, none of them peculiar to it alone. The Surinam toad is well known to produce its young, not in the ordinary way, but in cells upon its back. Mr Sherwood has very lately diſcovered the ſmall eels in ſour paſte to be without exception full of living young ones. And as to the moſt amazing of all its properties, the reproduction of its parts, we know the crab and lobſter, if a leg be broken off, always produce a new one: and Monſ. Bonnet, Monſ. Lyonet, Monſ. de Reaumur, and Mr Folkes, have all found, by experiment, that ſeveral earth and water worms have the ſame property, ſome of them even when cut into thirty pieces. The urtica marina, or ſea-nettle, has been alſo found to have the ſame; and the ſea ſtar fiſh, of which the polype is truly a ſpecies, though it had long eſcaped the ſearches of the naturaliſts, was always well known by the fiſhermen to have it alſo.

Marine POLYPUS, is different in form from the freſh-water polype already deſcribed; but is nouriſhed, increaſes, and may be propagated, after the ſame manner; Mr Ellis having often found, in his inquiries, that ſmall pieces cut off from the living parent, in order to view the ſeveral parts more accurately, ſoon gave indications that they contained not only the principles of life, but likewiſe the faculty of increaſing and multiplying into a numerous iſſue. It has been lately diſcovered and ſufficiently proved by Peyſſonel, Ellis, Juſſieu, Reaumur, Donati, &c. that many of thoſe ſubſtances which had formerly been conſidered by naturaliſts as marine vegetables or ſea-plants, are in reality animal-productions; and that they are formed by polypes of different ſhapes and ſizes, for their habitation, defence, and propagation. To this claſs may be referred the corals, corallines, keratophyta, eſchara, ſponges, and alcyonium: nor is it improbable, that the more compact bodies, known by the common appellations of *ſtar-ſtones*, *brain-ſtones*, *petrified fungi*, and the like, brought from various parts of the Eaſt and Weſt Indies, are of the ſame origin. To this purpoſe Mr Ellis obſerves, that the ocean, in all the warmer latitudes near the ſhore, and wherever it is poſſible to obſerve, abound ſo much with animal life, that no inanimate body can long remain unoccupied by ſome ſpecies. In thoſe regions, ſhips'-bottoms are ſoon covered with the habitations of thouſands of animals: rocks, ſtones, and every thing lifeleſs, are covered with them inſtantly; and even the branches of living vegetables that hang into the water are immediately loaded with the ſpawn of different animals, ſhell-fiſh of various kinds: and ſhell-fiſh themſelves, when they become impotent and old, are the baſis of new colonies of animals, from whoſe attacks they can no longer defend themſelves. For a farther account of this ſyſtem, ſee CORAL and CORALLINES.

POLYPUS of the Heart. See MEDICINE, n° 97, 98, 274, and 290.

POLYSARCIA, or CORPULENCY. See MEDICINE, n° 335.

POLYSCHIDES, or SEA HUNGER. See FUCUS.

POLYSPERMOUS (from ϖολυ and σπερμα *ſeed*), in botany, is applied to ſuch plants as have more than four ſeeds ſucceeding each flower, without any certain order or number.

POLYSYLLABLE, in grammar, a word conſiſting of more than three ſyllables; for when a word conſiſts of one, two, or three ſyllables, it is called a *monoſyllable*, a *diſſyllable*, and *triſyllable*.

POLYSYNDETON. See ORATORY, n° 67.

POLYTHEISM,

1 Definition.

THE doctrine of a plurality of gods or inviſible powers ſuperior to man.

* Sketches of the Hiſt. of Man.

"That there exiſt beings, one or many, powerful above the human race, is a propoſition (ſays Lord Kames*) univerſally admitted as true in all ages and among all nations. I boldly call it *univerſal*, notwithſtanding what is reported of ſome groſs ſavages; for reports that contradict what is acknowledged to be general among men, require more able vouchers than a few illiterate voyagers. Among many ſavage tribes, there are no words but for objects of external ſenſe: it is ſurpriſing that ſuch people are incapable of expreſſing their religious perceptions, or any perception of internal ſenſe? The conviction that men have of ſuperior powers, in every country where there are words to expreſs it, is ſo well vouched, that in fair reaſoning it ought to be taken for granted among the few tribes where language is deficient."

2 Source of religious principles traced

Theſe are judicious obſervations, of which every man will admit the force who has not ſome favourite ſyſtem to build upon the unſtable foundation which his Lordſhip overturns. Taking it for granted, then, that our conviction of ſuperior powers has long been univerſal, the important queſtion is, From what cauſe it proceeds? The ſame ingenious author ſhows, with great ſtrength of reaſoning, that the operations of nature and the government of this world, which to us loudly proclaim the exiſtence of a Deity, are not ſufficient to account for the univerſal belief of ſuperior beings among ſavage tribes. He is therefore of opinion, that this univerſality of conviction can ſpring only from the image of Deity ſtamped upon the mind of every human being, the ignorant equally with the learned. "Nothing leſs (he ſays) is ſufficient: and the original perception which we have of Deity muſt proceed (he thinks) from an internal ſenſe, which may be termed the *ſenſe of Deity*."

We have elſewhere expreſſed our opinion of that philoſophy which accounts for every phenomenon in human nature, by attributing it to a particular inſtinct (ſee INSTINCT); but to this inſtinct or *ſenſe of Deity*, conſidered as complete evidence, many objections, more than uſually powerful, force themſelves upon us. All nations, except the Jews, were once polytheiſts and idolaters. If therefore his Lordſhip's hypotheſis be admitted, either the doctrine of polytheiſm muſt be true theology, or this inſtinct or ſenſe is of ſuch a nature as to have at different periods of the world miſled all mankind. All ſavage tribes are at preſent polytheiſts and idolaters; but among ſavages every inſtinct appears in greater purity and vigour than among people poliſhed by arts and ſciences; and inſtinct never miſtakes its object. The inſtinct or primary impreſſion of nature, which gives riſe to ſelf-love, affection between the ſexes, love of progeny, &c. has in all nations, and in every period of time, a preciſe and determinate object which it inflexibly purſues. How then comes it to paſs, that this particular inſtinct, which if real is ſurely of as much importance as any other, ſhould have uniformly led thoſe who had no other guide to purſue improper objects, to fall into the groſſeſt errors and the moſt pernicious practices? To no purpoſe are we told, that the ſenſe of Deity, like the moral ſenſe, makes no capital figure among ſavages. There is reaſon to believe that the feeling or perception, which is called the *moral ſenſe*, is not wholly inſtinctive; but whether it be or not, a ſingle inſtance cannot be produced in which it multiplies its objects, or makes even a ſavage expreſs gratitude to a thouſand perſons for benefits which his prince alone had power to confer.

For theſe, and other reaſons which might eaſily be aſſigned, we cannot help thinking, that the firſt religious principles muſt have been derived from a ſource different as well from internal ſenſe as from the deductions of reaſon; from a ſource which the majority of mankind had early forgotten; and which, when it was baniſhed from their minds, left nothing behind to prevent the very firſt principle of religion from being perverted by various accidents or cauſes, or, in ſome extraordinary concurrence of circumſtances, from being perhaps entirely obliterated. This ſource of religion every conſiſtent Theiſt muſt believe to be revelation. Reaſon, it is acknowledged, and we ſhall afterwards ſhow (ſee RELIGION), could not have introduced ſavages to the knowledge of God; and we have juſt ſeen, that a *ſenſe* of Deity is an hypotheſis clogged with inſuperable difficulties. Yet it is undeniable, that all mankind have believed in ſuperior inviſible powers: and if reaſon and inſtinct be ſet aſide, there remains no other origin of this

3 To revelation.

this univerſal belief that primeval revelation, corrupted, indeed, as it paſſed by oral tradition from father to ſon, in the courſe of many generations. It is no ſlight ſupport to this doctrine, that if there really be a Deity*, it is highly preſumable, that he would reveal himſelf to the firſt men—creatures whom he had formed with faculties to adore and to worſhip him. To other animals, the knowledge of a Deity is of no importance; to man, it is of the firſt importance. Were we totally ignorant of a Deity, this world would appear to us a mere chaos. Under the government of a wiſe and benevolent Deity, chance is excluded; and every event appears to be the reſult of eſtabliſhed laws. Good men ſubmit to whatever happens without repining, knowing that every event is ordered by Divine Providence: they ſubmit with entire reſignation; and ſuch reſignation is a ſovereign balſam for every misfortune or evil in liſe.

* See Sketches of the Hiſt. of Man.

4
Which taught pure theiſm.

Admitting, then, that the knowledge of Deity was originally derived from revelation, and that the firſt men profeſſed pure theiſm, it ſhall be our buſineſs in the preſent article to trace the riſe and progreſs of *polytheiſm* and *idolatry*; and to aſcertain, if we can, the real opinions of the Pagan world concerning that multitude of gods with which they filled heaven, earth, and hell. In this inquiry, though we ſhall have occaſion to appeal to the writings of Moſes, we ſhall attribute to them no other authority than what is due to records of the earlieſt ages, more ancient and authentic than any others which are now extant.

Whether we believe, with the author of the book of Geneſis, that all men have deſcended from the ſame progenitors; or adopt the hypotheſis of modern theoriſts, that there have been ſucceſſive creations of men, and that the *European* derives his origin from one pair, the *Aſiatic* from another, the woolly-headed *African* from a third, and the copper-coloured *American* from a fourth—polytheiſm and idolatry will be ſeen to have ariſen from the ſame cauſes, and to have advanced nearly in the ſame order from one degree of impiety to another. On either ſuppoſition, it muſt be taken for granted, that the original progenitors were inſtructed by their Creator in the truths of genuine theiſm: and there is no room to doubt, but that thoſe truths, ſimple and ſublime as they are, would be conveyed pure from father to ſon as long as the race lived in one family, and were not ſpread over a large extent of country. If any credit be due to the records of antiquity, the primeval inhabitants of this globe lived to ſo great an age, that they muſt have increaſed to a very large number long before the death of the common parent, who would of courſe be the bond of union to the whole ſociety, and whoſe dictates, eſpecially in what related to the origin of his being and the exiſtence of his Creator, would be liſtened to with the utmoſt reſpect by every individual of his numerous progeny.

Many cauſes, however, would conſpire to diſſolve this family, after the death of its anceſtor, into ſeparate and independent tribes, of which ſome would be driven by violence, or would voluntarily wander, to a diſtance from the reſt. From this diſperſion great changes would take place in the opinions of ſome of the tribes reſpecting the object of their religious worſhip. A ſingle family, or a ſmall tribe baniſhed into a deſert wilderneſs (ſuch as the whole earth muſt then have been), would find employment for all their time in providing the means of ſubſiſtence, and in defending themſelves from beaſts of prey. In ſuch circumſtances they would have little *leiſure* for meditation, and, being conſtantly converſant with objects of ſenſe, they would gradually loſe the *power* of meditating upon the ſpiritual nature of that Being by whom their anceſtors had taught them that all things were created. The firſt wanderers would no doubt retain in tolerable purity their original notions of Deity; and they would certainly endeavour to impreſs thoſe notions upon their children: but in circumſtances infinitely more favourable to ſpeculation than theirs could have been, the human mind dwells not long upon notions purely intellectual. We are ſo accuſtomed to ſenſible objects, and to the ideas of ſpace extenſion, and figure, which they are perpetually impreſſing upon the imagination, that we find it extremely difficult to conceive any being without aſſigning to him a form and a place. Hence a learned writer* has ſuppoſed, that the earlieſt generations of men (even thoſe to whom he contends that frequent revelations were vouchſafed) may have been no better than *anthropomorphites* in their conceptions of the Divine Being.

5
Circumſtances which led to polytheiſm.

* Biſhop Law in his Conſiderations on the Theory of Religion.

6
Firſt ſteps in the progreſs.

Be this as it may, it is not conceivable but that the members of thoſe firſt colonies would quickly loſe many of the arts and much of the ſcience which perhaps prevailed in the parent ſtate; and that fatigued with the contemplation of intellectual objects, they would relieve their overſtrained faculties, by attributing to the Deity a place of abode, if not a human form. To men totally illiterate, the place fitteſt for the habitation of the Deity would undoubtedly appear to be the ſun, the moſt beautiful and glorious object of which they could form any idea; an object, too, from which they could not but be ſenſible that they received the benefits of light and heat, and which experience muſt ſoon have taught them to be in a great meaſure the ſource of vegetation. The great ſpirit therefore inhabiting the ſun, which they would conſider as the *power* of light and heat, was in all probability the firſt object of idolatrous adoration.

7
The ſpirit of light the firſt god of paganiſm.

From looking upon the ſun as the habitation of their God, they would ſoon proceed to conſider it as his body. Of pure mind entirely ſeparated from matter, men in their circumſtances could not long retain the fainteſt notion; but conſcious each of power in himſelf, and experiencing the effects of power in the ſun, they would naturally conceive that luminary to be animated as their bodies were animated. They would feel his influence when above the horizon; they would ſee him moving from eaſt to weſt; they would conſider him when ſet as gone to take his repoſe: and thoſe exertions and intermiſſions of power being analagous to what they experienced in themſelves, they would look upon the ſun as a real animal. Thus would the Divinity appear to their untutored minds to be a compound being like man, partly corporeal and partly ſpiritual; and as ſoon as they imbibed ſuch notions, though perhaps not before, they may be pronounced to have been abſolute idolaters.

When man had once got into this train, their gods would multiply upon them with wonderful rapidity. Darkneſs and cold they could not but perceive to be contrary to light and heat; and not having philoſophy enough to diſtinguiſh between mere privations and poſitive effects, they would conſider darkneſs and cold as entities equally real with light and heat; and attribute theſe different and contrary effects to different and contrary powers. Hence the ſpirit or power of darkneſs was in all probability the ſecond god in the Pagan calendar; and as they conſidered the power of light as a benevolent principle, the ſource of all that is good, they muſt have looked upon the contrary power of darkneſs as a malevolent ſpirit, the ſource of all that is evil. This we know from authentic hiſtory to have been the belief of the Perſian magi, a very ancient ſect, who called their good god *Yazdan*, and alſo *Ormuzd*, and the evil god *Abraman*. Conſidering light as the ſymbol, or perhaps as the body, of *Ormuzd*, they always worſhipped him before the fire, the ſource of light, and eſpecially before the ſun, the ſource of the moſt perfect light; and for the ſame reaſon fires were kept continually burning on his altars. That they ſometimes addreſſed prayers to the evil principle, we are informed by Plutarch in his life of Themiſtocles; but with what particular rites he was worſhipped, or where he was ſuppoſed to reſide, is not ſo evident. Certain it is, that his worſhippers held him in deteſtation; and when they had occaſion to write his name, they always inverted it *(uɐɯɐɹq∀)*, to denote the malignity of his nature. 8 The ſpirit or power of darkneſs the ſecond. 9 Polytheiſm of the Perſian magi.

The principles of the magi, though widely diſtant from pure theiſm, were much leſs abſurd than thoſe of other idolaters. It does not appear that they ever worſhipped their gods by the medium of graven images, or had any other emblems of them than light and darkneſs. Indeed we are told by Diogenes Laertius and Clemens Alexandrinus, that they condemned all ſtatues and images allowing fire and water to be the only proper emblems or repreſentatives of their gods. And we learn from Cicero *, that at their inſtigation Xerxes was ſaid to have burnt all the temples of Greece, becauſe the builders of thoſe edifices impiouſly preſumed to incloſe within walls the gods, to whom all things ought to be open and free, and whoſe proper temple is the whole world. To theſe authorities we may add that of all the hiſtorians, who agree, that when magianiſm was the religion of the court, the Perſian monarchs made war upon images, and upon every emblem of idolatry different from their own.

10 Sabian polytheiſm. The Magi, however, were but one ſect, and not the largeſt ſect of ancient idolaters. The worſhip of the ſun, as the ſource of light and heat, ſoon introduced into the calendar of divinities the other heavenly bodies, the moon, the planets, and the fixed ſtars. Men could not but experience great benefit from thoſe luminaries in the abſence of their chief god; and when they had proceeded ſo far as to admit two divine principles, a good and an evil, it was natural for minds clouded with ſuch prejudices to conſider the moon and the ſtars as benevolent intelligences, ſent to oppoſe the power of darkneſs whilſt their firſt and greateſt divinity was abſent or aſleep. It was thus, as they imagined, that he maintained (for all held that he did maintain) a conſtant ſuperiority over the evil principle. Though to aſtronomers the moon is known to be an opake body of very ſmall dimenſions when compared with a planet or a fixed ſtar, to the vulgar eye ſhe appears much more magnificent than either. By thoſe early idolaters ſhe was conſidered as the divinity ſecond in rank and in power; and whilſt the ſun was worſhipped as the king, ſhe was adored as the queen, of heaven.

The earth, conſidered as the common mother of all things; the ocean, whoſe waters are never at reſt; the air, the region of ſtorms and tempeſts, and indeed all the elements—were gradually added to the number of divinities; not that mankind in this early age had ſo far degenerated from the principles of their anceſtors as to worſhip brute matter. If ſuch worſhip was ever practiſed, which to us is hardly conceivable, it was at a later period, when it was confined to the very loweſt of the vulgar, in nations otherwiſe highly civilized. The polytheiſts, of whom we now treat, conceived every thing in motion to be animated, and animated by an intelligence powerful in proportion to the magnitude of the body moved.

This ſect of idolaters, which remains in ſome parts of the Eaſt to this day, was known by the name of *Sabians*, which they pretend to have derived from *Sabius* a ſon of Seth; and among the books in which their ſacred doctrines are contained, they have one which they call the book of *Seth*. We need hardly obſerve, that theſe are ſenſeleſs and extravagant fables. The name *Sabian* is undoubtedly derived from the Hebrew word *Tſaba*, which ſignifies "a hoſt or army;" and this claſs of polytheiſts was ſo called, becauſe they worſhipped "the hoſt of heaven;" the *Tſaba heſemim*, againſt which Moſes ſo pathetically cautions the people of Iſrael *.

11 Aroſe in Chaldea. This ſpecies of idolatry is thought to have firſt prevailed in Chaldea, and to have been that from which Abraham ſeparated himſelf, when, at the command of the true God, he "departed from his country, and from his kindred, and from his father's houſe." But as it nowhere appears that the Chaldeans had fallen into the ſavage ſtate before they became polytheiſts and idolaters, and as it is certain that they were not ſavages at the call of Abraham, their early Sabiiſm may be thought inconſiſtent with the account which we have given of the origin of that ſpecies of idolatry. If a great and civilized nation was led to worſhip the hoſt of heaven, why ſhould that worſhip be ſuppoſed to have ariſen among ſavages? Theories, however plauſible, cannot be admitted in oppoſition to facts.

True: but we beg leave to reply, that our account of the origin of polytheiſm is oppoſed by no fact; becauſe we have not ſuppoſed that the worſhip of the hoſt of heaven aroſe among ſavages *only*. That ſavages, between whom it is impoſſible to imagine any intercourſe to have had place, have univerſally worſhipped, as their firſt and ſupreme divinities, the *ſun*, *moon*, and *ſtars*, is a fact evinced by every hiſtorian and by every traveller; and we have ſhown how their rude and uncultivated ſtate naturally leads them to that ſpecies of idolatry. But there may have been circumſtances peculiar to the Chaldeans, which led them likewiſe to the worſhip of the heavenly hoſt, even in a ſtate of high civilization.—We judge of the philoſophy of the ancients by that of ourſelves, and imagine that the ſame refined ſyſtem of metaphyſics was cultivated by them as by the followers of *Deſcartes* and *Locke*. But this is a great miſtake; for ſo groſs were the notions of early antiquity, that it may be doubted whether there was a ſingle man unınſpired, who had any notion of mind as a being diſtinct and entirely ſeparated from matter (ſee **Metaphysics**, Part III. c. 4). From ſeveral paſſages in the books of Moſes, we learn, that when in the firſt ages of the world the Supreme Being condeſcended to manifeſt his preſence to men, he generally exhibited ſome ſenſible emblem of his power and glory, and declared his will from the miſt of a preternatural *fire.* It was thus that he appeared to the Jewiſh lawgiver himſelf, when he ſpoke to him from the midſt of a burning buſh; it was by a pillar of cloud and *fire* that he led the Iſraelites from Egypt to the land of Promiſe; and it was in the midſt of ſmoke, and *fire*, and thunderings, that the law was delivered from Mount Sinai.—That ſuch manifeſtations of the Divine Preſence would be occaſionally made to the deſcendants of Noah who ſettled in Chaldea ſoon after the deluge, muſt appear extremely probable to every one who admits the authority of the Hebrew Scriptures: and he who queſtions that authority, has no right to make the objection to which we now reply; becauſe it is only from the book of Geneſis that we know the Chaldeans to have been a civilized people when they fell into idolatry. All hiſtories agree in repreſenting the inhabitants of Chaldea as at a very early period corrupted by luxury and ſunk in vice. When this happened, we muſt ſuppoſe that the moral Governor of the univerſe would withdraw from them thoſe occaſional manifeſtations of himſelf, and leave them to their own inventions. In ſuch circumſtances, it was not unnatural for a people addicted to the ſtudy of aſtronomy, who had been taught to believe that the Deity frequently appeared to their anceſtors in a flame of fire, to conſider the ſun as the place of his permanent reſidence, if not as his body. But when either opinion was firmly eſtabliſhed, polytheiſm would be its inevitable conſequence, and the progreſs of Sabiiſm would, in the moſt poliſhed nation, be ſuch as we have traced it among ſavage tribes.

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* De Legibus, lib. ii. § 10.

* Deut. c. iv. 19.

12
Paſſed into Egypt, &c.

From Chaldea the idolatrous worſhip of the hoſt of heaven ſpread itſelf over all the Eaſt, paſſed into Egypt, and thence into Greece; for Plato affirms †, that "the firſt inhabitants of Greece ſeemed to him to have worſhipped no other gods but the ſun, moon, earth, ſtars, and heavens, as moſt barbarous nations (continues he) ſtill do." That Sabiiſm, or the worſhip of the hoſt of heaven, was the firſt ſpecies of idolatry, beſides the probability of the thing, and the many alluſions to it in ſacred Scripture, we have the poſitive evidence of the moſt ancient pagan hiſtorians of whoſe writings any part has been tranſmitted to us. Herodotus *, ſpeaking of the religion of the Perſians, ſays, that "they worſhip the *ſun*, *moon*, and *earth*, *fire*, *water*, and the *winds*; and this adoration they have all along paid from the beginning." He teſtifies the ſame thing of the ſavage Africans, of whom he affirms †, that they all worſhipped the *ſun*, and *moon*, and no other divinity. Diodorus Siculus, writing of the Egyptians ‡, tells us, that "the firſt men looking up to the world above them, and terrified and ſtruck with admiration at the nature of the univerſe, ſuppoſed the ſun and moon to be the principal and *eternal gods*." And Sanchoniathon the Phœnician, a more ancient writer than either of theſe, informs us, in the fragment of his hiſtory preſerved by Euſebius, that "the two firſt mortals were Æon and Protogonus; and their children were Genus and Genea, who inhabited Phœnicia; and when they were ſcorched with the heat, they lifted up their hands to the ſun, whom they believed to be the Lord of Heaven, and called him *Baal-ſamen*, the ſame whom the Greeks call Ζευς."

13
And produced ſtatue worſhip.

Hitherto thoſe divinities were worſhiped in perſon, or, as Dr Prideaux expreſſes it, in their *ſacella*, or ſacred tabernacles; for the votaries of each directed their devotions towards the planet which they ſuppoſed to be animated by the particular intelligence whom they meant to adore. But theſe orbs, by their riſing and ſetting, being as much below the horizon as above it, and their groſsly ignorant worſhippers not ſuppoſing it poſſible that any intelligence, however divine, could exert its influence but in union with ſome body, ſtatues or pillars were ſoon thought of as proper emblems of the abſent gods. Sanchoniathon, in the fragment already quoted, informs us, that "*Hyſpouranios* and his brother *Ouſous*, Phœnician patriarchs, erected two pillars, the one to *fire*, and the other to *air* or *wind*, and worſhipped thoſe pillars, pouring out to them libations of the blood of the wild beaſts hunted down in the chace." As theſe early monuments of idolatry were called βαιτυλια, a word evidently derived from the Hebrew *Bethel*, the probability is, that they were altars of looſe ſtones, ſuch as that which was built by Jacob §, and from him received the ſame name. As his was conſecrated to the true God, theirs were conſecrated to the hoſt of heaven; and the form of conſecration ſeems to have been nothing more than the anointing of the ſtone or pillar with oil (A), in the name of the divinity whom it was intended to repreſent. When this ceremony was performed, the ignorant idolaters, who fancied that their gods could not hear them but when they were viſible, ſuppoſed that the intelligences by which the ſun and planets were animated, took poſſeſſion, in ſome inexplicable manner, of the conſecrated pillars, and were as well pleaſed with the prayers and praiſes offered up before thoſe pillars, as with the devotions which were addreſſed towards the luminaries themſelves.—Hence Sanchoniathon calls them *animated* or *living*, *ſtones*, λιθους εμψυχους, from the portion of the Divine Spirit which was believed to reſide in them; and as they were dedicated to the hoſt of heaven, they were generally erected on the tops of mountains; or in countries which, like Egypt, were low and level, they were elevated to a great height by the labour of men.

14
With the idolatry of high places.

It has been ſuppoſed, that this practice of raiſing the pillars on *high places* proceeded from a deſire to make the objects of worſhip conſpicuous and magnificent: but we are ſtrongly inclined to believe, that the erectors of Βαιτυλια had ſomething farther in view, and that they thought of nothing leſs than to bring the ſacred ſtone or pillar as near as poſſible to the god whom it repreſented. Whatever be in this, we know that the practice itſelf prevailed univerſally through the eaſt; and that

† In Cratyl.

* Lib. i. cap. 131.

† Lib. iv. cap. 188.

‡ Lib. I.

§ Geneſis, ch. xxxv.

(A) Hence the proverb of a ſuperſtitious man, παντα λιθον λιπαρον προσκυνει, *he kiſſes or adores every anointed ſtone*; which Arnobius calls *lubricatam lapidem, et ex olivi unguine ſordidatum.*—Stillingfleet's *Origines Sacræ.*

there was nothing which the Jewiſh legiſlator more ſtrictly enjoined his people to deſtroy, than the altars, ſtatues, and pillars, erected for idolatrous worſhip upon mountains and high places. "Ye ſhall utterly deſtroy (ſays he) all the places wherein the nations which ye ſhall poſſeſs ſerved their gods, upon the *high mountains*, and upon the *hills*, and under every green tree. And ye ſhall overthrow their *altars*, and break down their *pillars*, and burn their *groves* with fire*."

The mention of *groves* by the Hebrew lawgiver, brings to our recollection another ſpecies of idolatry, which was perhaps the ſecond in order, as men deviating from the principles of pure theiſm were more and more intangled in the labyrinths of error. The Chaldeans, Egyptians, and all the eaſtern nations who believed in a ſuperintending providence, imagined that the government of this world, the care of particular nations, and even the ſuperintendence of groves, rivers, and mountains, in each nation, was committed by the gods to a claſs of ſpirits ſuperior to the ſoul of man, but inferior to thoſe heavenly intelligences which animated the ſun, the moon, and the planets. Theſe ſpirits were by the Greeks called *δαιμονες*, *dæmons*, and by the Romans *genii*. Timæus the Locrian, who flouriſhed before Plato, ſpeaking of the puniſhment of wicked men, ſays†, all theſe things hath Nemeſis decreed to be executed in the ſecond period, by the miniſtry of vindictive terreſtrial dæmons, who are overſeers of human affairs; to which dæmons, the Supreme God, the ruler over all, hath committed the government and adminiſtration of this world, which is made up of *gods*, *men*, and *animals*.

15
Origin of dæmon-worſhip

Concerning the origin of theſe intermediate beings, ſcholars and philoſophers have framed various hypotheſes. The belief of their exiſtence may have been derived from five different ſources.

1. It ſeems to have been impoſſible for the limited capacities of thoſe men, who could not form a notion of a God diveſted of a body and a place, to conceive how the influence and agency of ſuch a being could every inſtant extend to every point of the univerſe. Hence, as we have ſeen, they placed the heavenly regions under the government of a multitude of heavenly gods, the *ſun*, the *moon*, and the *ſtars*. But as the neareſt of thoſe divinities was at an immenſe diſtance from the earth, and as the intelligence animating the earth itſelf had ſufficient employment in regulating the general affairs of the whole globe, a notion inſinuated itſelf into the untutored mind, that theſe ſuperior governors of univerſal nature found it neceſſary, or at leaſt expedient, to employ ſubordinate intelligences or *dæmons* as miniſters to execute their beheſts in the various parts of their widely extended dominions.

2. Such an univerſal and uninterrupted courſe of action, as was deemed neceſſary to adminiſter the affairs of the univerſe, would be judged altogether inconſiſtent with that ſtate of *indolence*, which, eſpecially in the eaſt, was held an indiſpenſable ingredient in perfect felicity. It was this notion, abſurd as it is, which made Epicurus deny the *providence*, whilſt he admitted the *exiſtence* of gods. And if it had ſuch an effect upon a philoſopher who in the moſt enlightened ages had many followers, we need not ſurely wonder if it made untaught idolaters imagine that the governor or governors of the univerſe had devolved a great part of their trouble on deputies and miniſters.

3. When men came to reflect on the infinite diſtance between themſelves and the gods, they would naturally form a wiſh, that there might ſomewhere exiſt a claſs of intermediate intelligences, whom they might employ as mediators and interceſſors with their far diſtant divinities. But what men earneſtly wiſh, they very readily believe. Hence the ſuppoſed diſtance of their gods would, among untutored barbarians, prove a fruitful ſource of intermediate intelligences, more pure and more elevated than human ſouls.

4. Theſe three opinions may be denominated popular; but that which we are now to ſtate, wherever it may have prevailed, was the offspring of philoſophy.—On this earth we perceive a ſcale of beings riſing gradually above each other in perfection, from mere brute matter through the various ſpecies of foſſils, vegetables, inſects, fiſhes, birds, and beaſts, up to man. But the diſtance between man and God is infinite, and capable of admitting numberleſs orders of intelligences, all ſuperior to the human ſoul, and each riſing gradually above the other till they reach that point, wherever it may be, at which creation ſtops. Part of this immenſe chaſm the philoſophers perceived to be actually filled by the heavenly bodies; for in *philoſophical* polytheiſm there was one inviſible God ſupreme over all theſe: but ſtill there was left an immenſe vacuity between the human ſpecies and the moon, which was known to be the loweſt of the heavenly hoſt; and this they imagined muſt certainly be occupied by inviſible inhabitants of different orders and diſpoſitions, which they called good and evil *dæmons*.

5. There is yet another ſource from which the univerſal belief of good and evil demons may be derived, with perhaps greater probability than from any or all of theſe. If the Moſaic account of the creation of the world, the peopling of the earth, and the diſperſion of mankind, be admitted as true (and a more conſiſtent account has not as yet been given or deviſed), ſome knowledge of good and evil *angels* muſt neceſſarily have been tranſmitted from father to ſon by the channel of oral tradition. This tradition would be corrupted at the ſame time, and in the ſame manner, with others of greater importance. When the true God was ſo far miſtaken as to be conſidered, not as the ſole governor of the univerſe, but only as the ſelf-exiſtent power of light and good, the Devil would be elevated from the rank of a rebellious created ſpirit to that of the independent power of darkneſs and evil; the angels of light would be transformed into good demons, and thoſe of darkneſs into demons that are evil. This account of the origin of dæmonology receives no ſmall ſupport from Plato, who derives one branch of it wholly from tradition. "With reſpect to thoſe demons (ſays he‡) who inhabit the ſpace between the earth and the moon, to underſtand and declare their generation is a taſk too arduous for my ſlender abilities. In this caſe we muſt credit the report of men of other times, who, according to their own account, were the deſcendants of the gods, and had, by ſome means or other, gained exact intelligence of that myſtery from their anceſtors. We muſt not queſtion the veracity of the children of the gods, even though they ſhould tranſgreſs the bounds

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* Deut. xii. 23.

† De Anima Mundi, inter ſcript. a T. Gale, editos.

‡ Timæus.

of probability, and produce no evidence to ſupport their aſſertions. We muſt, I ſay, notwithſtanding, give them credit, becauſe they profeſs to give a detail of facts with which they are intimately acquainted, and the laws of our country oblige us to believe them."

Though theſe dæmons were generally inviſible, they were not ſuppoſed to be pure diſembodied ſpirits.—Proclus, in his Commentary upon Plato's Timæus, tells us, that "every dæmon ſuperior to human ſouls conſiſted of an intellectual mind and an ethereal vehicle." Indeed it is very little probable, that thoſe who gave a body and a place to the Supreme God, ſhould have thought that the inferior orders of his miniſters were ſpirits entirely ſeparated from matter. Plato himſelf divides the claſs of dæmons into three orders*; and whilſt he holds their ſouls to be particles or emanations from the divine eſſence, he affirms that the bodies of each order of dæmons are compoſed of that particular element in which they for the moſt part reſide. "Thoſe of the firſt and higheſt order are compoſed of pure ether; thoſe of the ſecond order conſiſt of groſſer air; and dæmons of the third or loweſt rank have vehicles extracted from the element of water. Dæmons of the firſt and ſecond orders are inviſible to mankind. The aquatic dæmons, being inveſted with vehicles of groſſer materials, are ſometimes viſible and ſometimes inviſible. When they do appear, though faintly obſervable by the human eye, they ſtrike the beholder with terror and aſtoniſhment." Dæmons of this laſt order were ſuppoſed to have paſſions and affections ſimilar to thoſe of men; and though all nature was full of them, they were believed to have local attachments to mountains, *rivers*, and *groves*, where their appearances were moſt frequent. The reaſon of theſe attachments ſeems to be obvious. Polytheiſm took its riſe in countries ſcorched by a burning ſun; and dæmons by their compoſition being neceſſarily ſubject in ſome degree to the influence of heat and cold, it was natural to ſuppoſe that they, like men, would delight in the ſhady grove and in the purling ſtream. Hence the earlieſt altars of paganiſm were generally built in the midſt of *groves*, or on the banks of *rivers*; becauſe it was believed that in ſuch places were aſſembled multitudes of thoſe intelligences, whoſe office it was to regulate the affairs of men, and to carry the prayers and oblations of the devout to the far-diſtant reſidence of the celeſtial gods. Hence too are to be derived the mountain and river gods, with the dryads and hamadryads, the ſatyrs, nymphs, and fawns, which held a place in the creed of ancient paganiſm, and make ſo conſpicuous a figure in the Greek and Roman poets.

16
In groves, and on the banks of rivers.

Theſe different orders of intelligences, which, though worſhipped as gods or demigods, were yet believed to partake of human paſſions and appetites, led the way to the deification of departed heroes and other eminent benefactors of the human race. By the philoſophers all ſouls were believed to be emanations from the divinity; but "gratitude † and admiration, the warmeſt and moſt active affections of our nature, concurred to enlarge the object of religious worſhip, and to make man regard the inventors of arts and the founders of ſociety as having in them more than a common ray of the divinity. So that god-like benefits, beſpeaking as it were a god-like mind, the deceaſed parent of a people was eaſily advanced into the rank of dæmon. When the religious bias was in ſo good a train, natural affection would have its ſhare in promoting this new mode of adoration. Piety to parents would naturally take the lead, as it was ſupported by gratitude and admiration, the *primum mobile* of the whole ſyſtem: and in thoſe early ages, the *natural father* of the tribe often happened to be the *political father* of the people, and the founder of the ſtate. Fondneſs for the offspring would next have its turn; and a diſconſolate father, at the head of a people, would contrive to ſooth his grief for the untimely death of a favourite child, and to gratify his pride under the want of *ſucceſſion*, by paying divine honours to its memory." "For a father ‡ afflicted with untimely mourning, when he had made an image of his child ſoon taken away, now honoured him as a god, who was then a dead man, and delivered to thoſe that were under him ceremonies and ſacrifices." That this was the origin and progreſs of the worſhip of departed ſouls, we have the authority of the famous fragment of Sanchoniathon already quoted, where the various motives for this ſpecies of idolatry are recounted in expreſs words. "After many generations (ſays he) came *Chryſor*; and he invented many things uſeful to civil life, for which, after his deceaſe, he was worſhipped as a *god*. Then flouriſhed *Ouranos* and his ſiſter *Ge*, who deified and offered ſacrifices to their father *Hypſiſtos*, when he had been torn in pieces by wild beaſts. Afterwards *Cronos* conſecrated *Muth* his ſon, and was himſelf conſecrated by his ſubjects."

17
Deification of departed heroes,

In the reign of Cronos flouriſhed a perſonage of great reputation for wiſdom, who by the Egyptians was called *Thoth*, by the Phœnicians *Taautos*, and by the Greeks *Hermes*. According to Plutarch, he was a profound politician, and chief counſellor to Oſiris, then the king, and afterwards the principal divinity, of Egypt: and we are told by *Philo Byblius*, the tranſlator of Sanchoniathon, "that it was this *Thoth* or *Hermes* who firſt took the matters of religious worſhip out of the hands of unſkilful men, and brought them into due method and order." His object was to make religion ſerviceable to the intereſts of the ſtate. With this view he appointed *Oſiris* and other departed princes to be joined with the ſtars and worſhipped as gods; and being by Cronos made king of Egypt, he was, after his death, worſhipped himſelf as a god by the Egyptians. To this honour, if what is recorded of him be true, he had indeed a better title than moſt princes; for he is ſaid to have been the inventor of letters, arithmetic, geometry, aſtronomy, and hieroglyphics, and was therefore one of the greateſt benefactors of the human race which any age or country has ever produced.

18
A political invention which introduced

That the gods of Greece and Rome were derived from Egypt and Phœnicia, is ſo univerſally known, that it is needleſs to multiply quotations in order to prove that the progreſs of polytheiſm among the Greeks and Romans was the ſame with that which we have traced in more ancient nations. The following tranſlation, however, of the account given by Heſiod of the deification of departed heroes, with which we have been favoured by a learned and ingenious friend, is ſo juſt, and in our opinion ſo beautiful, that we cannot deny ourſelves the pleaſure of giving it to our readers.

"The gods who dwell on high Olympus' hill,
Firſt fram'd a golden race of men, who liv'd
Under old Saturn's calm auſpicious ſway.
Like gods they liv'd, their hearts devoid of care,

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* Epinionis.

† Warburton's Div. Leg.

‡ Wiſdom of Solomon xiv. 15.

Beyond the reach of pain and piercing woes;
Th' infirmities of age nor felt, nor fear'd.
Their nerves with youthful vigour ſtrung, their days
In jocund mirth they paſt, remote from ills.—
Now when this godlike race was lodg'd in earth,
By Jove's high will to demigods they roſe,
And airy dæmons, who benign on earth
Converſe—the guides and guardians of mankind.
In darkneſs veil'd, they range earth's utmoſt bound,
Diſpenſing wealth to mortals. This reward
From bounteous Jove awaits illuſtrious deeds ||."

19 National and tutelar gods.

The deification of departed heroes and ſtateſmen was that which in all probability introduced the univerſal belief of *national* and *tutelar* gods, as well as the practice of worſhipping thoſe gods through the medium of *ſtatues* cut into a *human figure*. When the founder of a ſtate or any other public benefactor was elevated to the rank of a god, as he was believed ſtill to retain human paſſions and affections, it was extremely natural to ſuppoſe that he would regard with a favourable eye that nation for which he had done ſo much upon earth; that he would oppoſe its enemies, and protect the laws and inſtitutions which he himſelf had given it. By indulging the ſame train of ſentiment, each city, and even every family of conſequence, found *Lares* and *Penates* among their departed anceſtors, to whom they paid the warmeſt adoration, and under whoſe protection they believed their private affairs to be placed. As thoſe national and houſehold gods were believed to be in their deified ſtate clothed with airy bodies, ſo thoſe bodies were ſuppoſed to retain the form which their groſſer bodies had upon earth. The image of a departed friend might perhaps be formed by the hand of ſorrowful affection, before the ſtatue or the ſhrine of a deity was thought of; but when that friend or benefactor became the object of religious adoration, it was natural for his votaries to enliven their devotion by the view of his ſimilitude. Maximus Tyrius tells us §, that "there is no race of men, whether barbarian or Grecian, living on the ſea-coaſt or on the continent, wandering in deſerts or living in cities, which hath not conſecrated ſome kind of ſymbol or other in honour of the gods." This is certainly true; but there is no good evidence that the firſt ſymbols of the gods were ſtatues of men and women. Whilſt the ſun and other heavenly bodies continued to be the ſole objects of religious worſhip, the ſymbols conſecrated to them were pillars of a *conical* or *pyramidal* figure; and if ſuch pillars are ever called *graven* images by Moſes and other ancient writers, it was probably on account of the *allegoric figures* and *characters*, or hieroglyphic writing, with which they were inſcribed.

20 Hero-worſhip engrafted on the planetary.

Hitherto we have conſidered the ſouls of departed heroes as holding the rank only of demons or demigods; but they gradually roſe in the ſcale of divinities, till they dethroned the heavenly bodies, and became themſelves the *dii majorum gentium*. This revolution was effected by the combined operation of the prince and the prieſt; and the firſt ſtep taken towards it ſeems to have been the complimenting of their heroes and public benefactors with the name of that being which was moſt eſteemed and worſhipped. "Thus a king for his beneficence was called the *ſun*, and a queen for her beauty the *moon*. Diodorus relates, that Sol firſt reigned in Egypt, called ſo from the luminary of that name in the heavens. This will help us to underſtand an odd paſſage in the fragment of Sanchoniathon, where it is ſaid that *Cronus had ſeven ſons by Rhea, the youngeſt of whom was a* GOD *as ſoon as* BORN. The meaning probably is, that this youngeſt ſon was called after ſome luminary in the heavens to which they paid divine honours; and theſe honours came in proceſs of time to be transferred to the terreſtrial nameſake. The ſame hiſtorian had before told us, that the ſons of Genos, mortals like their father, were called by the names of the elements—*light*, *fire*, and *flame*, of which they had diſcovered the uſe."

21 Which in time it ſupplanted.

"As this adulation advanced into an eſtabliſhed worſhip, they turned the compliment the other way, and called the planet or luminary after the hero, the better to accuſtom the people, even in the act of *Planet-Worſhip*, to this *new* adoration. Diodorus, in the paſſage already quoted, having told us, that by the firſt inhabitants of Egypt the ſun and moon were ſuppoſed to be the principal and eternal gods, adds, that the former was called Osiris, and the latter Isis. This was indeed the general practice; for we learn from Macrobius, that the Ammonites called the ſun *Moloch*; the Syrians *Adad*; the Arabs *Dionyſus*; the Aſſyrians *Belus*; the Phœnicians *Saturn*; the Carthaginians *Hercules*; and the Palmyrians *Elegabalus*. Again, by the Phrygians the moon was called *Cybele*, or the mother of the gods; by the Athenians *Minerva*; by the Cyprians *Venus*; by the Cretans *Diana*; by the Sicilians *Proſerpine*; by others *Hecate*, *Bellona*, *Veſta*, *Urania*, *Lucina*, &c. Philo Byblius explains this practice: "It is remarkable (ſays he) that the ancient idolators impoſed on the *elements*, and on thoſe parts of nature which they eſteemed gods, *the names of their kings*: for the natural gods which they acknowledged were only the ſun, moon, planets, elements, and the like; they being now in the humour of having gods of both claſſes, the *mortal* and the *immortal*."

"As a farther proof that *hero*-worſhip was thus ſuperinduced upon the *planetary*, it is worthy of obſervation, that the firſt ſtatues conſecrated to the *greater* hero-gods—thoſe who were ſuppoſed to be *ſupreme*—were not of a human form, but *conical* or *pyramidal*, like thoſe which in the earlieſt ages of idolatry were dedicated to the ſun and planets. Thus the ſcholiaſt on the Veſpæ of Ariſtophanes tells us, that the ſtatues of Apollo and Bacchus were *conic* pillars or obeliſks; and Pauſanias, that the ſtatue of Jupiter Meilichius repreſented a *pyramid*; that of the Argive Juno did the ſame, as appears from a verſe of Phoronis quoted by Clemens Alexandrinus ‡; and indeed the practice was univerſal as well amongſt the early barbarians as amongſt the Greeks. But it is well known that the ancients repreſented the *rays of light* by pillars of a conical or pyramidal form; and therefore it follows, that when they erected ſuch pillars as repreſentatives of their hero-gods, theſe latter had ſucceeded to the titles, rights, and honours of the *natural* and *celeſtial divinities**.’

But though it ſeems to be certain that *hero*-worſhip was thus engrafted on the *planetary*, and that ſome of thoſe heroes in proceſs of time ſupplanted the planets themſelves, this was ſuch a revolution in theology as could not have been ſuddenly effected by the united influence of the prince and the prieſt. We doubt not

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|| Εργων και ἡμερων, lib. i. verſ. 100, &c.

§ Diſſert. 38.

‡ Strom. l. 1.

* Warburton's Div. Leg. book 3. ſect. 6.

22 Progreſs of this revolution in theology. the fact that SOL was believed to have reigned in Egypt, and was afterwards worſhipped under the name of *Oſiris*; but it was ſurely impoſſible to perſuade any nation, however ſtupid or prone to idolatry, that a man, whom they *remembered* diſcharging the duties of their ſovereign and legiſlator, was the identical ſun whom they beheld in the heavens. Oſiris, if there was in Egypt a king of that name, may have been deified immediately after his death, and honoured with that worſhip which was paid to good *dæmons*; but he muſt have been dead for ages before any attempt was made to perſuade the nation that he was the *ſupreme God*. Even then great addreſs would be requiſite to make ſuch an attempt ſucceſsful. The prince or prieſt who entered upon it would probably begin with declaring from the oracle, that the divine intelligence which animates and governs the ſun had deſcended to earth and animated the perſon of their renowned legiſlator; and that, after their laws were framed, and the other purpoſes ſerved for which the deſcent was made, the ſame intelligence had returned to its original reſidence and employment among the celeſtials. The poſſibility of this double tranſmigration from heaven to earth and from earth to heaven, would without difficulty be admitted in an age when the pre-exiſtence of ſouls was the univerſal belief. Having proceeded thus far in the apotheoſis of dead men, the next ſtep taken in order to render it in ſome degree probable that the early founders of ſtates, and inventors of arts, were divine intelligences clothed with human bodies, was to attribute to one ſuch benefactor of mankind the actions of many of the ſame name. Voſſius, who employed vaſt erudition and much time on the ſubject, has proved, that before the æra of the Trojan wars moſt kings who were very powerful, or highly renowned for their ſkill in legiſlation, &c. were called *Jove;* and when the actions of all theſe were attributed to one *Jove* of *Crete*, it would be eaſy for the crafty prieſt, ſupported by all the power and influence of the ſtate, to perſuade an ignorant and barbarous people, that he whoſe wiſdom and heroic exploits ſo far ſurpaſſed thoſe of ordinary men muſt have been the ſupreme God in human form.

23 Vices of the pagan gods. This ſhort ſketch of the progreſs of polytheiſm and idolatry will enable the reader to account for many circumſtances recorded of the pagan gods of antiquity, which at firſt view ſeem very ſurpriſing, and which at laſt brought the whole ſyſtem into contempt among the philoſophers of Athens and Rome. The circumſtances to which we allude are the immoral characters of thoſe divinities, and the abominable rites with which they were worſhipped. Jupiter, Apollo, Mars, and the whole rabble of them, are deſcribed by the poets as raviſhers of women and notorious adulterers. Hermes or Mercury was a thief, and the god of thieves. Venus was a proſtitute, and Bacchus a drunkard. The malice and revenge of Juno were implacable; and ſo little regard was any of them ſuppoſed to pay to the laws of honour and rectitude, that it was a common practice of the Romans, when beſieging a town, to evocate the tutelar deity, and to tempt him by a reward to betray his friends and votaries †. In a word, they were, in the language of the poet,

> "Gods partial, changeful, paſſionate, unjuſt,
> "Whoſe attributes were rage, revenge, and luſt."

24 Accounted for. This was the natural conſequence of their origin. Having once animated human bodies, and being ſuppoſed ſtill to retain human paſſions and appetites, they were believed, in their ſtate of deification, to feel the ſame ſenſual deſires which they had felt upon earth, and to purſue the ſame means for their gratification. As the men could not well attempt to ſurpaſs the gods in purity and virtue, they were eaſily perſuaded by artful and profligate prieſts, that the moſt acceptable worſhip which could be rendered to any particular deity was to imitate the example of that deity, and to indulge in the practices over which he preſided. Hence the worſhip of Bacchus was performed during the night by men and women mixing in the dark after intemperate eating and drinking. Hence too it was the practice in Cyprus and ſome other countries to ſacrifice to Venus the virginity of young women ſome days before their marriage, in order, as it was pretended, to ſecure their chaſtity ever afterwards; and, if Herodotus may be credited, every woman among the Babylonians was obliged once in her life to proſtitute herſelf in the temple of the goddeſs *Mylitte* (Venus), that ſhe might thenceforward be proof againſt all temptation.

25 Progreſs of idolatry regular and univerſal. The progreſs of polytheiſm, as far as we have traced it, has been regular; and after the enormous error of forſaking the worſhip of the true God was admitted, every ſubſequent ſtep appears to be natural. It would be no difficult taſk to prove that it has likewiſe been univerſal. Sir William Jones, the learned preſident of the Aſiatic Society, has diſcovered ſuch a ſtriking reſemblance between the gods of ancient Greece and thoſe of the pagans of Hindoſtan †, as puts it beyond a doubt that thoſe divinities had the ſame origin. The GANESA of the Hindoos he has clearly proved to be the JANUS of the Greeks and Romans. As the latter was repreſented with two and ſometimes with four faces, as emblems of prudence and circumſpection, the former is painted with an elephant's head, the well-known ſymbol among the Indians of ſagacious diſcernment. 26 Indian idolatry. The SATURN of Greece and Rome appears to have been the ſame perſonage with the MENU or SATYAVRATA of Hindoſtan, whoſe patronymic name is VAIVASWATA, or *child of the ſun*; which ſufficiently marks his origin. Among the Romans there were many Jupiters, of whom one appears from Ennius to have been nothing more than the firmament perſonified.

> Aſpice hoc ſublime candens, quem invocant omnes
> JOVEM.

But this Jupiter had the ſame attributes with the Indian god of the viſible heavens called INDRA or the *king*, and DIVESPETIR or the *lord of the ſky*, whoſe conſort is *Sachi*, and whoſe weapon is *vajra* or the thunderbolt. INDRA is the regent of winds and ſhowers; and though the eaſt is peculiarly under his care, yet his Olympus is the north pole, allegorically repreſented as a mountain of gold and gems. With all his power he is conſidered as a ſubordinate deity, and far inferior to the Indian triad BRAHMA, VISHNOU, and MAHADEVA or SIVA*, who are three forms of one and the ſame godhead. The preſident having traced the reſemblance between the idolatry of Rome and India through many other gods, obſerves, that "we muſt not be ſurpriſed at finding, on a cloſe examination, that the characters of all the pagan deities melt into each other, and at laſt into one or two; for it ſeems a well-founded opinion, that the whole crowd of gods and goddeſſes in ancient Rome, and likewiſe in Hindoſtan, mean only the powers of nature, and principally thoſe of the ſun, expreſſed in a variety of ways, and by a multitude of fanciful names."

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† T. Livii, l. v. c. 21. et Macrob. Satur. lib. iii, c. 9.

† Aſiatic Reſearches, vol. i.

* Plate CCCCXI.

Nor is it only in Greece, Rome, Egypt, and India, that the progreſs of idolatry has been from planetary to hero-worſhip. From every account which modern travellers have given us of the religion of ſavage nations, it appears that thoſe nations adore, as their firſt and greateſt gods, the ſun, moon, and ſtars; and that ſuch of them as have any other divinities have proceeded in the ſame road with the celebrated nations of antiquity, from the worſhip of the heavenly bodies to that of celeſtial demons, and from celeſtial demons to the deification of dead men. It appears likewiſe that they univerſally believe their hero-gods and demi-gods to retain the paſſions, appetites, and propenſities of men.

27 Scandinavian and Saxon idolatry.

That the Scandinavians and our Saxon anceſtors had the ſame notions of the gods with the other pagans whoſe opinions we have ſtated, is evident from their calling the days of the week by the names of their divinities, and from the forms of the ſtatues by which thoſe divinities were repreſented *. 1. The idol of the ſun, from which *Sunday* is derived, among the Latins *dies Solis*, was placed in a temple, and adored and ſacrificed to; for they believed that the ſun did co-operate with this idol. He was repreſented like a man half naked, with his face like the ſun, holding a burning wheel with both hands on his breaſt, ſignifying his courſe round the world; and by its fiery gleams, the light and heat with which he warms and nouriſheth all things.—2. The idol of the moon, from which cometh our *Monday*, *dies Lunæ*, anciently *Moonday*, appears ſtrangely ſingular, being habited in a ſhort coat like a man. Her holding a moon expreſſes what ſhe is; but the reaſon of her ſhort coat and long-eared cap is loſt in oblivion.—3. *Tuiſco*, the moſt ancient and peculiar god of the Germans, repreſented in his garment of a ſkin according to their ancient manner of clothing, was next to the ſun and moon, the idol of higheſt rank in the calendar of northern paganiſm. To him the third day in the week was dedicated; and hence is derived the name *Tueſday*, anciently *Tuiſday*, called in Latin *dies Martis*, though it muſt be confeſſed that Mars does not ſo much reſemble this divinity as he does Odin or Woden.

* Plate CCCCXI.

4. *Woden* was a valiant prince among the Saxons. His image was prayed to for victory over their enemies; which, if they obtained, they uſually ſacrificed the priſoners taken in battle to him. Our *Wedneſday* is derived from him, anciently *Wodneſday*. The northern hiſtories make him the father of *Thor*, and *Friga* to be his wife.

5. *Thor* was placed in a large hall, ſitting on a bed canopied over, with a crown of gold on his head, and 12 ſtars over it, holding a ſceptre in the right hand. To him was attributed the power over both heaven and earth; and that as he was pleaſed or diſpleaſed he could ſend thunder, tempeſts, plagues, &c. or fair, ſeaſonable weather, and cauſe fertility. From him our *Thurſday* derives its name, anciently *Thorſday*; among the Romans *dies Jovis*, as this idol may be ſubſtituted for Jupiter.

6. *Frigo* repreſented both ſexes, holding a drawn ſword in the right hand and bow in the left; denoting that women as well as men ſhould fight in times of need. She was generally taken for a goddeſs; and was reputed the giver of peace and plenty, and cauſer of love and amity. Her day of worſhip was called by the Saxons *Frigedeag*, now *Friday*, *dies Veneris*; but the habit and weapons of this figure have a reſemblance of Diana rather than Venus.

7. *Seater*, or *Crodo*, ſtood on the prickly back of a perch. He was thin-viſaged and long-haired, with a long beard, bare-headed and bare-footed, carrying a pail of water in his right hand wherein are fruit and flowers, and holding up a wheel in his left, and his coat tied with a long girdle. His ſtanding on the ſharp fins of this fiſh ſignified to the Saxons, that by worſhipping him they ſhould paſs through all dangers unhurt; by his girdle flying both ways was ſhown the Saxons freedom; and by the pail with fruit and flowers, was denoted that he would nouriſh the earth. From him, or from the Roman deity Saturn, comes *Saturday*.

Such were the principal gods of the northern nations: but theſe people had at the ſame time inferior deities, who were ſuppoſed to have been tranſlated into heaven for their heroic deeds, and whoſe greateſt happineſs conſiſted in drinking *ale* out of the ſkulls of their enemies in the *hall of Woden*. But the limits preſcribed to the preſent article do not permit us to purſue this ſubject; nor is it neceſſary that we ſhould purſue it. The attentive reader of the article MYTHOLOGY, of the hiſtories given in this work of the various divinities of paganiſm, and of the different nations by whom thoſe divinities were worſhipped, will perceive that the progreſs of polytheiſm and idolatry has been uniform over the whole earth.

28 Brute-worſhip of the Egyptians.

There is, however, one ſpecies of idolatry more wonderful than any thing that has yet been mentioned, of which our readers will certainly expect ſome account. It is the worſhip of *brutes*, *reptiles*, and *vegetables*, among the Egyptians. To the Greeks and Romans, as well as to us, that ſuperſtition appeared ſo monſtrous, that to enumerate every hypotheſis, ancient and modern, by which philoſophers have endeavoured to account for it, would ſwell this article beyond all proportion. Brute-worſhip prevailed at ſo early a period in Egypt, that the philoſophers of antiquity, whoſe writings have deſcended to us, had little or no advantage over the moderns in purſuing their reſearches into its origin; and among the modern hypotheſes, thoſe of *Moſheim* and *Warburton* appear to us by much the moſt probable of any that we have ſeen (B). The former of theſe learned writers attributes it wholly to the policy of the prince and

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(B) There is, however, another hypotheſis worthy of ſome attention, if it were only for the learning and ingenuity of its author. The celebrated Cudworth infers, from the writings of Philo and other Platoniſts of the Alexandrian ſchool, that the ancient Egyptians held the Platonic doctrine of ideas exiſting from eternity, and conſtituting, in one of the perſons of the godhead, the intelligible and archetypal world. (See PLATONISM.) Philo, and the craft of the prieſt. The latter contends, with much earneſtneſs and ingenuity, that it reſulted from the uſe of hieroglyphic writing. We are ſtrongly inclined to believe that both theſe cauſes contributed to the production of ſo portentous an effect; and that the uſe of hieroglyphics as ſacred ſymbols, after they were laid aſide in civil life, completed that wonderful ſuperſtition which the craft of the prieſt and the policy of the prince had undoubtedly begun.

29
Introduced with a political view.

We learn from Herodotus*, that in his time the number of uſeful animals in Egypt was ſo ſmall as hardly to be ſufficient for tillage and the other purpoſes of civil life; whilſt ſerpents and other noxious animals, ſuch as the crocodile, wolf, bear, and hippopotamus, abounded in that country. From this fact Moſheim very naturally concludes†, that the founders of ſociety and government in Egypt would by every art endeavour to increaſe the number of uſeful animals as the number of inhabitants increaſed; and that with this view they would make it criminal to kill or even to hurt ſheep, cows, oxen, or goats, &c. whilſt they would wage perpetual war upon the noxious animals and beaſts of prey. Such animals as were aſſiſting to them in the carrying on of this warfare would be juſtly conſidered as in a high degree uſeful to ſociety. Hence the moſt grievous puniſhments were decreed againſt the killing, or ſo much as the wounding, of the *ichneumon* and *ibis*; becauſe the former was looked upon as the inſtinctive enemy of the crocodile, and the latter of every ſpecies of ſerpents*. The learned writer, however, obſerves, that in Egypt as in other countries, people would be tempted to ſacrifice the good of the public to the gratification of their own appetites, and ſometimes even to the indulgence of a momentary caprice. Hence he thinks it was found neceſſary to ſtrengthen the authority of the laws enacted for the preſervation of uſeful animals by the ſanctions of religion: and he ſays, that with this view the prieſts declared that certain animals were under the immediate protection of certain gods; that ſome of thoſe animals had a divine virtue reſiding in them; and that they could not be killed without the moſt ſacrilegious wickedneſs, incurring the higheſt indignation of the gods. When once the idolatrous Egyptians were perſuaded that certain animals were ſacred to the immortal gods, and had a divine virtue reſiding in them, they could not avoid viewing thoſe animals with ſome degree of veneration; and the prieſts, taking advantage of the ſuperſtition of the people, appointed for each ſpecies of ſacred animals appropriated rites and ceremonies, which were quickly followed with building ſhrines and temples to them, and approaching them with oblations, and ſacrifices, and other rites of divine adoration.

To corroborate this hypotheſis, he obſerves, that, beſides the animals ſacred over all Egypt, each province and each city had its particular animal to which the inhabitants paid their devotions. This aroſe from the univerſal practice among idolaters of conſecrating to themſelves *Lares* and *Penates*; and as the animals which were worſhipped over the whole kingdom were conſidered as ſacred to the *Dii majorum gentium*, ſo the animals whoſe worſhip was confined to particular cities or provinces were ſacred to the *Lares* of thoſe cities and provinces. Hence there was in Upper Egypt a city called *Lycopolis*, becauſe its inhabitants worſhipped the wolf, whilſt the inhabitants of *Thebes* or *Heliopolis* paid their devotions to the eagle, which was probably looked upon as ſacred to the ſun. Our author, however, holds it as a fact which will admit of no diſpute, that there was not one noxious animal or beaſt of prey worſhipped by the Egyptians till after the conqueſt of their country by the Perſians. That the earlieſt gods of Egypt were all benevolent beings, he appeals to the teſtimony of Diodorous Siculus; but he quotes Herodotus and Plutarch, as agreeing that the latter Egyptians worſhipped an evil principle under the name of *Typhon*. This *Typhon* was the inveterate enemy of *Oſiris*, juſt as *Ahraman* was of *Ormuzd*; and therefore he thinks it in the higheſt degree probable that the Egyptians derived their belief of two ſelf-exiſtent principles, a good and an evil, from their Perſian conquerors, among whom that opinion prevailed from the earlieſt ages.

From whatever ſource their belief was derived, Typhon was certainly worſhipped in Egypt, not with a view of obtaining from him any good, for there was nothing good in his nature, but in hopes of keeping him quiet, and averting much evil. As certain animals had long been ſacred to all the benevolent deities, it was natural for a people ſo beſotted with ſuperſtition as the Egyptians to conſecrate emblems of the ſame kind to their god Typhon. Hence aroſe the worſhip of *ſerpents*, *crocodiles*, *bears*, and other noxious animals and beaſts of prey. It may indeed ſeem at firſt ſight very inconſiſtent to deify ſuch animals, after they had been in the practice for ages of worſhipping others for being

* Lib. 2. c. 65.

† Cudworth, Intellect. Syſt. cap. 4. n° 158.

* See Ichneumon and Ibis.

Philo, he obſerves, did not himſelf conſider thoſe ideas as ſo many diſtinct *ſubſtances* and *animals*, much leſs as *gods*; but he mentions others who deified the whole of this intelligible ſyſtem as well as its ſeveral parts. Hence, when they paid their devotions to the *ſenſible ſun*, they pretended to worſhip only the divine *idea* or *archetype* of that luminary: and hence, thinks our learned author, the ancient Egyptians, by falling down to bulls, and cows, and crocodiles, meant at firſt to worſhip only the divine and eternal *ideas* of thoſe animals. He allows, indeed, that as few could entertain any thoughts at all of thoſe eternal ideas, there were ſcarcely any who could perſuade themſelves that the *intelligible ſyſtem* had ſo much reality in it as the *ſenſible things of nature*; and hence he thinks the devotion which was originally paid to the divine ideas had afterwards no higher object than the brutes and vegetables of which thoſe ideas were the eternal patterns.

This hypotheſis is ingenious, but not ſatisfactory. There is no evidence that the myſterious doctrine of Plato concerning *ideas* had anywhere been thought of for ages after brute-worſhip was eſtabliſhed in Egypt. Of the ſtate of Egyptian theology at that early period, Philo, and the other philoſophers of the Alexandrian ſchool, had no better means of forming a judgment than we have; and they laboured under many Grecian prejudices, which muſt have prevented them from judging with our impartiality.

their deſtroyers; but it is to be remembered, that long before the deification of crocodiles, &c. the real origin of brute-worſhip was totally forgotten by the people, if they were ever acquainted with it. The crafty prieſt who wiſhes to introduce a gainful ſuperſtition, muſt at firſt employ ſome plauſible reaſon to delude the multitude; but after the ſuperſtition has been long and firmly eſtabliſhed, it is obviouſly his buſineſs to keep its origin out of ſight.

Such is Moſheim's account of the origin and progreſs of that ſpecies of idolatry which was peculiar to Egypt; and with reſpect to the *riſe* of *brute*-worſhip, it appears perfectly ſatisfactory. But the Egyptians worſhipped ſeveral ſpecies of vegetables; and it ſurely could be no part of the policy of wiſe legiſlators to preſerve *them* from deſtruction, as vegetables are uſeful only as they contribute to animal ſubſiſtence. We are therefore obliged to call in the aid of Warburton's hypotheſis to account for this branch of Egyptian ſuperſtition.

30 Continued by the means of hieroglyphic writing, and

That learned and ingenious author having proved *, with great clearneſs and ſtrength of argument, that hieroglyphic writing was prior to the invention of alphabetic characters; and having traced that kind of writing from ſuch rude pictures, as thoſe which were in uſe among the Mexicans, through all the different ſpecies of what he calls *euriologic*, *tropical*, and *ſymbolic* hieroglyphics (See HIEROGLYPHICS)—ſhows, by many quotations from ancient authors, that the Egyptian prieſts wrapt up their theology in the ſymbolic hieroglyphics, after alphabetic characters had baniſhed from the tranſactions of civil life a mode of communicating information neceſſarily ſo obſcure. Theſe ſymbols were the figures of animals and vegetables, denoting, from ſome imaginary analogy, certain attributes of their divinities; and when the vulgar, forgetting this analogy, ceaſed to underſtand them as a ſpecies of writing, and were yet taught to conſider them as ſacred, they could not well view them in any other light than as emblems of the divinities whom they adored. But if rude ſculptures upon ſtone could be emblematical of the divinities, it was ſurely not unnatural to infer, that the living animals and vegetables which thoſe ſculptures repreſented muſt be emblems of the ſame divinities more ſtriking and more ſacred. Hence the learned author thinks aroſe that wonderful ſuperſtition peculiar to the Egyptians, which made them worſhip not only animals and vegetables, but alſo a thouſand chimeras of their own creation; ſuch as figures with human bodies and the heads or feet of brutes, or with brutal bodies and the heads and feet of men.

Theſe two hypotheſes combined together appear to us to account ſufficiently for the idolatry of Egypt, monſtrous as it was. We are perſuaded, that with reſpect to the *origin* of brute worſhip, Moſheim is in the right (c); and it was a very eaſy ſtep for people in ſo good training to proceed upon the crutches of hieroglyphics to the worſhip of plants and thoſe chimeras, which, as they never had a real exiſtence in nature, could not have been thought of as emblems of the divinity, had they not been uſed in that ſymbolic writing which Warburton ſo ably and ingeniouſly explains.

To this account of the origin of brute-worſhip we are fully aware that objections will occur. From a learned friend, who peruſed the article in manuſcript, we have been favoured with one which, as it is exceedingly plauſible, we ſhall endeavour to obviate. "Brute-worſhip was not peculiar to Egypt. The Hindoos, it is well known, have a religious veneration for the cow and the alligator; but there is no evidence that in India the number of uſeful animals was ever ſo ſmall as to make the interference of the prince and the prieſt neceſſary for their preſervation; neither does it appear that the Hindoos adopted from any other people the worſhip of a ſelf-exiſtent principle of evil." Such is the objection. To which we reply,

31 Carried from Egypt into India.

That there is every reaſon to believe that brute-worſhip was introduced into India by a colony of Egyptians at a very remote period. That between theſe two nations there was an early intercourſe, is univerſally allowed: and though the learned preſident of the Aſiatic Society has laboured to prove, that the Egyptians derived all that wiſdom for which they were famed, as well as the rudiments of their religious ſyſtem, from the natives of Hindoſtan, he does not appear to us to have laboured with ſucceſs. To examine his arguments at length would ſwell this article beyond its due proportion; and we have noticed ſome of them elſewhere (ſee PHILOLOGY, n° 33 and 39.) At preſent we ſhall only obſerve, that Seſoſtris undoubtedly made an inroad into India, and conquered part of the country, whilſt we nowhere read of the Hindoos having at any time conquered the kingdom of Egypt. Now, though the victors have ſometimes adopted the religion of the vanquiſhed, the contrary has happened ſo much more frequently, and is in itſelf a proceſs ſo much more natural, that this ſingle circumſtance affords a ſtrong preſumption that the Egyptian monarch would rather impoſe his gods upon the Hindoos than adopt theirs and carry them with him to Egypt. Brute-worſhip might likewiſe be introduced into Hindoſtan by thoſe vaſt colonies of Egyptians who took refuge in that country from the tyranny and oppreſſion of the ſhepherd-kings. That ſuch colonies did ſettle on ſome occaſion or other in India, ſeems undeniable from monuments ſtill remaining in that country of forms which could hardly have occurred to a native of Aſia, though they are very natural as the workmanſhip of Africans. But we need not reaſon in this manner. We have ſeen a manuſcript letter from Mr Burt, a learned ſurgeon in Bengal, and a member of the Aſiatic Society, which puts it beyond a doubt that great numbers of Egyptians had at a very early

* Div. Leg. book 4th, ſect. 4th.

(c) To prove that it was merely to preſerve and increaſe the breed of uſeful animals in Egypt, that the prince and the prieſt *firſt* taught the people to conſider ſuch animals as ſacred, he argues thus: "Hæc ita eſſe, non ex eo tantum liquet, quod paulo ante obſervavi, nullas beſtias univerſo Ægyptiorum populo ſacras fuiſſe, præter eas, quæ manifeſtam regioni utilitatem comparant; ſed inde quoque apparet, quod longe major ratio habita fuit femellarum inter animalia, quam marium. Boves diis immolare licebat, vaccas nullo modo. Canes fœmina contumulabantur, non item mares." *Lege* HERODOT. *Hiſtor*. lib. ii. cap. 41. & cap. 67.

early period not only ſettled in Hindoſtan, but alſo brought with them writings relating to the hiſtory of their country. As the ſhepherd-kings were enemies to the arts and to literature, it is probable that this ſettlement took place on their conqueſt of Egypt. Mr Burt's words are: "Mr Wilford, lieutenant of engineers, has extracted moſt wonderful diſcoveries from the Shanſcrit records; ſuch as the origin and hiſtory of the Egyptian pyramids, and even the account of the expence in their building." Upon our hypotheſis there is nothing incredible in this account; upon the hypotheſis of Sir William Jones, it is not eaſy to be conceived how the hiſtory of *Egyptian* pyramids could have found a place in the *Shanſcrit* records.

We may admit that the Hindoos have never adopted from the Perſians or Egyptians the worſhip of an independent principle of evil, and yet diſpoſe of the other part of the objection with very little difficulty. It will be ſeen by and bye, that the bramins believe a kind of triad of hypoſtaſes in the divine nature, of which one is viewed as the *deſtroyer*, and known by ſeveral names, ſuch as *Siva* and *Iſwara*. When brute-worſhip was introduced into Hindoſtan, it was not unnatural to conſider the alligator as emblematical of *Iſwara;* and hence in all probability it is that the Hindoos believe that a man cannot depart more happily from this world than by falling into the Ganges, and being devoured by one of thoſe ſacred animals. Upon the whole, the brute-worſhip of the Hindoos, inſtead of militating againſt our account of that monſtrous ſuperſtition as it prevailed in Egypt, ſeems to lend no ſmall ſupport to that account, as there was unqueſtionably an early intercourſe between the two nations, and as colonies of Egyptians ſettled in India. To him who is not ſatisfied with our reaſoning on this ſubject, we beg leave to recommend an attentive peruſal of Maurice's *Indian Antiquities*, where he will find many facts brought together, which tend to prove that Egypt has a juſt claim to a higher antiquity than India.

32
Polytheiſts acknowledged one ſupreme God,

Having thus traced the riſe and progreſs of polytheiſm and idolatry as they prevailed in the moſt celebrated nations of antiquity, we now proceed to inquire into the real opinions of thoſe nations concerning the nature of the gods whom they adored. And here it is evident from the writings of Homer, Heſiod, and the other poets, who were the principal theologians among the Greeks and Romans, that though heaven, earth, hell, and all the elements, were filled with divinities, there was yet one who, whether called *Jove*, *Oſiris*, *Ormuzd*, or by any other title, was conſidered as ſupreme over all the reſt. "Whence each of the gods was generated (ſays Herodotus*), or whether they have all exiſted from eternity, and what are their *forms*, is a thing that was not known till very lately; for Heſiod and Homer were, as I ſuppoſe, not above four hundred years my ſeniors; and theſe were they who introduced the theogony among the Greeks, and gave the gods their ſeveral names." Now Heſiod †, towards the beginning of his theogony, expreſsly invokes his muſe to celebrate in ſuitable numbers the generation of the immortal gods who had ſprung from the earth, the dark night, the ſtarry heavens, and the ſalt ſea. He calls up on her likewiſe to ſay, "in what manner the gods, the earth, the rivers, ocean, ſtars, and firmament, were generated, and what divine intelligences had ſprung from them of benevolent diſpoſitions towards mankind." From this invocation, it is evident that the poet did not conſider the gods of Greece as ſelf-exiſtent beings: neither could he look upon them as *creatures;* for of creation the ancient Greeks had no conception (ſee METAPHYSICS, n° 264.); but he conſidered them as emanations coeval with the earth and heavens, from ſome ſuperior principles; and by the divine intelligences ſprung from them, there cannot be a doubt but that he underſtood benevolent dæmons. The firſt principles of all things, according to the ſame Heſiod, were *Chaos*, and *Tartarus*, and *Love;* of which only the laſt being active, muſt undoubtedly have been conceived by this father of Grecian polytheiſm to be the greateſt and only ſelf-exiſting god. This we ſay muſt undoubtedly have been Heſiod's belief, unleſs by *Tartarus* we here underſtand a ſelf-exiſtent principle of evil; and in that caſe his creed will be the ſame with that of the ancient Perſians, who, as we have ſeen, believed in the ſelf exiſtence as well of *Ahraman* as of *Ormuzd*.

33
From whom the other divinities were generated;

Heſiod is ſuppoſed to have taken his theology from Orpheus; and it is evident that his doctrine concerning the generation of the gods is the ſame with that taught in certain verſes* uſually attributed to Orpheus, in which Love and Chaos are thus brought together. "We will firſt ſing (ſays the poet) a pleaſant and delightful ſong concerning the ancient Chaos, how the heavens, earth, and ſeas, were formed out of it; as alſo concerning that all-wiſe *Love*, the oldeſt and ſelf-perfect principle, which actively produced all theſe things, ſeparating one from another." In the original paſſage, Love is ſaid not only to be πολυμητις of *much wiſdom* or *ſagacity*, and therefore a real intelligent ſubſtance; but alſo to be πρεσϐυτατος and αυτοτελες the *oldeſt* and *ſelf-perfect*, and therefore a being of ſuperior order to the other divinities who were generated together with the elements over which they were conceived to preſide.

With the theology of Homer our readers of all deſcriptions are ſo well acquainted, that we need not ſwell the article with quotations, to prove that the father of epic poetry held *Jove* to be the father of gods and men. But the doctrine of the poets was the creed of the vulgar Greeks and Romans; and therefore we may conclude, that thoſe nations, though they worſhipped gods and lords innumerable, admitted but one, or at the moſt two (D), ſelf-exiſtent principles; the one good and the other evil. It does not indeed appear, that in the

ſyſtem

* Lib. 2. c. 51.

† Verſ. 104—112.

* Argonaut. pag. 17. ed. Steph.

(D) Plutarch is commonly ſuppoſed, and we think juſtly ſuppoſed, to have been a believer in two ſelf-exiſtent principles, a good and an evil. His own opinion, whatever it was, he declares *(de Iſide et Oſiride)* to have been moſt ancient and univerſal, and derived from theologers and lawgivers by poets and philoſophers. "Though the firſt author of it be unknown yet (ſays he) it hath been ſo firmly believed *everywhere*, that traces of it are to be found in the ſacrifices and myſteries both of the *barbarians* and the *Greeks*. There is a confuſed mixture of good and evil in every thing, and nothing is produced by nature *pure*. Wherefore

34 Though each was by the vulgar conſidered as unaccountable in his own province.

ſyſtem of vulgar paganiſm the ſubordinate gods were accountable to their chief for any part of their conduct, except when they tranſgreſſed the limits of the provinces aſſigned them. Venus might conduct the amours of heaven and earth in whatever manner ſhe pleaſed; Minerva might communicate or with-hold wiſdom from any individual with or without reaſon; and we find, that in Homer's battles the gods were permitted to ſeparate into parties, and to ſupport the Greeks or Trojans according as they favoured the one or the other nation. Jove indeed ſometimes called them to order; but his interference was thought partial, and an inſtance of tyrannical force rather than of juſt authority. The vulgar Greeks, therefore, although they admitted but one, or at moſt two, ſelf-exiſtent principles, did not conſider the inferior divinities as mediators between them and the ſupreme, but as gods to whom their worſhip was on certain occaſions to be ultimately directed.

35 Creed of the philoſophers and

The creed of the philoſophers ſeems to have been different. Such of them as were theiſts, and believed in the adminiſtration of Providence, admitted of but one God, to whom worſhip was ultimately due; and they adored the ſubordinate divinities as his children and miniſters, by whom the courſe of Providence was carried on. With reſpect to the origin of thoſe divinities, Plato is very explicit; where he tells us[*], that "when all the gods, both thoſe who move viſibly round the heavens, and thoſe who appear to us as often as they pleaſe, were generated, that God, who made the whole univerſe, ſpoke to them after this manner: Ye gods of gods, of whom I myſelf am father, attend." Cicero teaches the very ſame doctrine with Plato concerning the gods[†]; and Maximus Tyrius, who ſeems to have underſtood the genius of polytheiſm as thoroughly as any man, gives us the following clear account of that ſyſtem as received by the philoſophers.

"I will now more plainly declare my ſenſe[‡] by this ſimilitude: Imagine a great and powerful kingdom or principality, in which all agree freely and with one conſent to direct their actions according to the will and command of one ſupreme king, the oldeſt and the beſt; and then ſuppoſe the bounds and limits of this empire not to be the river Halys, nor the Helleſpont, nor the Meotian lake, nor the ſhores of the ocean; but heaven above, and the earth beneath. Here then let that great king ſit immoveable, preſcribing to all his ſubjects laws, in the obſervance of which conſiſt their ſafety and happineſs: the partakers of his empire being many, both viſible and inviſible gods; ſome of which that are neareſt, and immediately attending on him, are in the higheſt regal dignity, feaſting as it were at the ſame table; others again are their miniſters and attendants; and a third ſort are inferior to them both: and thus you ſee how the order and chain of this government deſcends down by ſteps and degrees from the ſupreme God to the earth and men." In this paſſage we have a plain acknowledgment of one ſupreme God, the ſovereign of the univerſe, and of three inferior orders of gods, who were his miniſters in the government of the world; and it is worthy of obſervation, that the ſame writer calls theſe intelligences θεους θεου παιδας και φιλους, *gods, the ſons and friends of God.* He likewiſe affirms, that all ranks of men, and all nations on earth, whether barbarous or civilized, held the ſame opinions reſpecting one ſupreme Numen and the generation of the other gods.

"If there were a meeting (ſays he[*]) called of all theſe ſeveral profeſſions, a painter, a ſtatuary, a poet, and a philoſopher, and all of them were required to declare their ſenſe concerning *the God;* do you think that the painter would ſay one thing, the ſtatuary another, the poet a third, and the philoſopher a fourth? No; nor the Scythian neither, nor the Greek, nor the Hyperborean. In other things we find men ſpeaking very diſcordantly, all men as it were differing from all. But amidſt this war, contention, and diſcord, you may find everywhere, throughout the whole world, one uniform law and opinion, that there is ONE GOD, THE KING AND FATHER OF ALL, and many gods, the SONS OF GOD, who reign with God. Theſe things both the Greek and barbarian affirm, both the inhabitants of the continent and of the ſea-coaſt, both the wiſe and the unwiſe."

36 Indian Bramins.

This account of philoſophical polytheiſm receives no ſmall ſupport from the Aſiatic Reſearches of Sir William Jones. "It muſt always be remembered (ſays that accompliſhed ſcholar), that the learned Indians, as they are inſtructed by their own books, acknowledge only

[*] Timæus.

[†] Tuſc. Queſt. lib. 1. c. 29. et de Nat. Deorum, paſſim.

[‡] Diſſert. 1.

[*] Ibid.

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fore it is not one only diſpenſer of things, who, as it were, out of ſeveral veſſels diſtributeth theſe ſeveral liquors of good and evil, mingling them together, and daſhing them as he pleaſes; but there are two diſtinct and contrary powers or principles in the world, one of them always leading, as it were to the right hand, but the other tugging the contrary way. For if nothing can be made without a cauſe, and that which is good cannot be the cauſe of evil, there muſt needs be a diſtinct principle in nature for the production of evil as well as good."

That this is palpable manicheiſm (ſee MANICHEISM), appears to us ſo very evident, as to admit of no debate. It appeared in the ſame light to the learned Cudworth; but that author labours to prove that Plutarch miſtook the ſenſe of Pythagoras, Empedocles, Heraclitus, Anaxagoras, and Plato, when he attributed to them the ſame opinions which were held by himſelf. Moſheim, on the other hand, has put it beyond a doubt, that whatever was Plutarch's belief reſpecting the origin of evil and the exiſtence of two independent principles, it was taken implicitly from the writings of Plato. But the pious chancellor of *Gottingen*, actuated by the ſame motives with Cudworth, wiſhes to perſuade his readers, that by Plato and Plutarch nothing *active* was underſtood by their evil principle but only *that tendency to confuſion*, which was then deemed inſeparable from matter. But that ſomething more was meant ſeems undeniable; for immediately after the words which we have quoted, Plutarch proceeds to affirm that the wiſeſt men declare θεους ειναι δυο καθαπερ αντιτεχνους, *that there are two gods, as it were of contrary trades or crafts*, of which one is the author of all good and the other of all evil. See *Moſheim. ed. Cudworth. Syſtem. Intellect.* lib. i. cap. 4. § 13.

Plate CCCCXI.

only one Supreme Being, whom they call **Brahme**, or **the great one**, in the neuter gender. They believe his eſſence to be infinitely removed from the comprehenſion of any mind but his own; and they ſuppoſe him to manifeſt his power by the operation of his divine ſpirit, whom they name **Vishnou** the *pervader*, and **Ne'ra'yan** or *moving on the waters*, both in the maſculine gender; whence he is often denominated the *firſt male*. When they conſider the divine power as exerted in *creating* or giving exiſtence to that which exiſted not before, they call the deity **Brahma'**; when they view him in the light of *deſtroyer*, or rather *changer of forms*, they give him a thouſand names, of which **Siva**, **Iswara**, and **Mahadeva**, are the moſt common; and when they conſider him as the preſerver of created things, they give him the name of **Vishnou**. As the ſoul of the world, or the pervading *mind*, ſo finely deſcribed by Virgil, we ſee **Jove** repreſented by ſeveral Roman poets; and with great ſublimity by Lucan in the well known ſpeech of Cato concerning the Ammonian oracle. 'Jupiter is wherever we look, wherever we move.' This is preciſely the Indian idea of **Vishnou**: for ſince the power of preſerving created things by a ſuperintending providence belongs eminently to the godhead, they hold that power to exiſt tranſcendently in the *preſerving* member of the triad, whom they ſuppoſe to be **everywhere always**, not in ſubſtance, but in ſpirit and energy." This ſupreme god **Brahme**, in his triple form, is the only ſelf-exiſtent divinity acknowledged by the philoſophical Hindoos. The other divinities **Genesa**, **Indra**, **Cuvera**, &c. are all looked upon either as his creatures or his children; and of courſe are worſhipped only with inferior adoration.

37
Why the philoſophers worſhipped the inferior divinities.

It was upon this principle of the generation of the gods, and of their acting as miniſters to the ſupreme *Numen*, that all the philoſophers of Greece, who were not atheiſts, worſhipped many divinities, though they either openly condemned or ſecretly deſpiſed the traditions of the poets reſpecting the amours and villanies of Jupiter, Venus, Mercury, and the reſt of the tribe. It was the ſame principle ſincerely admitted, and not an ill-timed jeſt, as has been abſurdly ſuppoſed, that made Socrates, after he had ſwallowed the poiſon, requeſt his friend to offer a votive cock for him to Eſculapius.

But a theogony was not peculiar to the Greeks, Romans, and the Hindoos; it made part of every ſyſtem of polytheiſm. Even the Egyptians themſelves, the groſſeſt of all idolaters, believed in one ſelf-exiſting God, from whom all their other divinities deſcended by generation. This appears probable from the writings of Horus Apollo, Jamblicus, Porphyry, and many other ancient authors; but if the inſcription on the gates of the temple of *Neith* in *Sais*, as we have it from Plutarch and Proclus, be genuine, it will admit of no doubt. This famous inſcription, according to the laſt of theſe writers, was to this purpoſe: "I am whatever is, whatever ſhall be, and whatever hath been. My veil no man hath removed. The offſpring which I brought forth was the ſun (E)."

The Perſian magi, as we have ſeen, believed in two ſelf-exiſtent principles, a good and an evil: but if Diogenes Laertius deſerves to be credited, they held that fire, earth, and water, which they called gods, were generated of theſe two. It was obſerved in the beginning of this article, that the firſt object of idolatrous worſhip was probably the ſun, and that this ſpecies of idolatry took its riſe in Chaldea or Perſia. But when it became the practice of eaſtern monarchs to conceal themſelves wholly from their people, the cuſtom, as implying dignity, was ſuppoſed to prevail as well in heaven as on earth; and Zoroaſter, the reformer of the Perſian theology, taught*, that "Ormuzd was as far removed from the ſun as the ſun is removed from the earth." According to this modification of magianiſm, the ſun was one of the generated gods, and held the office of prime miniſter or vicegerent to the inviſible fountain of light and good. Still, however, a ſelf-exiſtent principle of evil was admitted; but though he could not be deſtroyed or annihilated by any power, it was believed that he would at laſt be completely vanquiſhed by Ormuzd and his miniſters, and rendered thenceforward incapable of producing any miſchief.

* Plutarch, de Iſide et Oſir.

From this ſhort view of polytheiſm, as we find it delineated by the beſt writers of antiquity, we think ourſelves warranted to conclude, that the whole pagan world believed in but *one*, or at moſt *two*, **self-existent gods**, from whom they conceived all the other divinities to have deſcended in a manner analogous to human generation. It appears, however, that the vulgar pagans conſidered each divinity as ſupreme and unaccountable within his own province, and therefore intitled to worſhip, which reſted ultimately in himſelf. The philoſophers, on the other hand, ſeem to have viewed the inferior gods as accountable for every part of their conduct to him who was their ſire and ſovereign, and to have paid to them only that inferior kind of devotion which the church of Rome pays to departed ſaints. The vulgar pagans were ſunk in the groſſeſt ignorance, from which ſtateſmen, prieſts, and poets, exerted their utmoſt influence to keep them from emerging; for it was a maxim which, however abſurd, was univerſally received, that "there were many things true in religion*, which it was not convenient for the vulgar to know; and ſome things which, though falſe, it was yet expedient that they ſhould believe." The polytheiſm and idolatry of the vulgar, therefore, was their misfortune rather than their fault. But the philoſophers were wholly "without excuſe*; becauſe that when they knew God, they glorified him not as God, neither were thankful, but became vain in their imaginations, and their fooliſh heart was darkened. Profeſſing themſelves wiſe, they became fools, and worſhipped and ſerved the creature more than the Creator, who is God bleſſed for ever."

38
Vulgar polytheiſts leſs culpable than the philoſophers.

* Varro apud D. Auguſt. de Civ. Dei.

* Rom. i. 20, 21, 22, 25.

(E) Τα οντα, και τα εσομενα, και τα γεγονοτα, εγω ειμι. Τον εμον χιτωνα ουδεις απεκαλυψεν. Ὁν εγω καρπον ετεκον, ἡλιος εγενετο. The antiquity of this inſcription is admitted by Cudworth, denied by Moſheim, and doubted by Jablonſki. The reader who wiſhes to know their arguments may conſult Moſheim's edition of the *Intellectual Syſtem*, and Jablonſki's *Pantheon Ægyptiorum*.

POLYTRICHUM, in botany: A genus of the order of muſci, belonging to the cryptogamia claſs of plants. The anthera is operculated, and placed upon a very ſmall apophyſis or articulation; the calyptra villous; the ſtar of the female is on a diſtinct individual. There are three ſpecies; the moſt remarkable of which is the commune, or great golden maiden-hair, frequently to be met with in the bogs and wet places of Britain. It grows in patches, the ſtalks erect, generally ſingle and unbranched, from three inches to a foot, or even a yard high. The leaves are numerous, ſtiff, lanceolate, acute, growing round the ſtalk without order, and, if viewed with a microſcope, appear to have their edges finely ſerrated. They are of a bright green when young and freſh, but reddiſh when dried or in decay: the filaments, or peduncles, are of a ſhining red, or orange colour, from two to four inches long, ariſing ſingly from the top of the ſtalks, and ſurrounded at their baſe with a cylindrical tubular vagina, or perichætium. The anthera, or capſule, is quadrangular, green at firſt, afterwards yellow, and red when ripe, having an annular pedeſtal, or apophyſis, at its baſe. The operculum is flat, with a projecting point in the centre; and underneath is a whitiſh circular membrane, placed in the middle of the capſule's orifice, and ſuſtained there by numerous arched threads, or cilia, connected by one end to the circumference of this membrane, and by the other faſtened to the ring of the anthera. The pollen, or, as others term it, the ſeed, is freed from the anthera or capſule through the ſpace between the cilia. The calyptra is twofold, an internal and external one; both which at firſt entirely cover and hang over the anthera. The internal one is conical, membranaceous, and ſmooth; the external one is compoſed only of tawny hairs, connected into a ſort of mat, lacerated at the baſe, and ſerving like a roof of thatch to defend the other. Beſides the ſtalks before deſcribed, there are commonly ſome others near at hand, which are deſtitute both of filaments and capſules, but are terminated with a kind of roſaceous cup, either of a bright red or yellowiſh colour, compoſed of leaves of different ſizes, the outermoſt broad, the innermoſt lanceolate, growing gradually more and more fine and ſlender to the centre. This cup is looked upon by Linnæus as the female flower of this moſs; but Haller is of opinion, that it is only the gem or origin of a new ſtalk, which frequently riſes from its centre. and this again becomes ſometimes proliferous. There are two varieties of this moſs: the firſt has much ſhorter ſtalks than the preceding, and often branched; the leaves ſtiffer, erect, and more crowded; in other reſpects the ſame. The other has a ſtalk ſcarcely more than half an inch high, terminated with a cluſter of linear, erect, rigid leaves, for the moſt part entire on the edges, and tipped each with a white hair. The filament is about an inch high, and the capſule quadrangular. The female flower, or gem, is of a bright red colour.

The firſt kind, when it grows long enough for the purpoſe, is ſometimes uſed in England and Holland to make brooms or bruſhes. Of the female ſort the Laplanders, when obliged to ſleep in deſert places, frequently make a ſpeedy and convenient bed. Their manner of doing it is curious: Where this moſs grows thick together, they mark out, with a knife, a piece of ground, about two yards ſquare, or of the ſize of a common blanket; then beginning at one corner, they gently ſever the turf from the ground, and as the roots of the moſs are cloſely interwoven and matted together, they by degrees ſtrip off the whole circumſcribed turf in one entire piece; afterwards they mark and draw up another piece, exactly correſponding with the firſt; then, ſhaking them both with their hands, they lay one upon the ground, with the moſs uppermoſt, inſtead of a mattraſs, and the other over it, with the moſs downwards, inſtead of a rug; and between them both take a comfortable nap, free from fleas and bugs, and without fear of contagious diſtempers. It is probable they might take the hint of making ſuch a bed from the bear, a cohabitant of their country, which prepares his winter-quarters with a large collection of this ſame moſs. See MUSCI, p. 473. and Plate CCCXXI.

POLYXÆNUS, or POLYÆNUS. See POLYÆNUS.

POLYXO, a prieſteſs of Apollo's temple in Lemnos. She was likewiſe nurſe to queen Hypſipyle. It was by her advice that the Lemnian women murdered all their huſbands.——There was another Polyxo, a native of Argos, who married Tlepolemus ſon of Hercules. She followed him to Rhodes after the murder of his uncle Licymnius; and when he departed for the Trojan war with the reſt of the Greek princes, ſhe became the ſole miſtreſs of the kingdom. After the Trojan war, Helen fled from Peloponneſus to Rhodes, where Polyxo reigned. Polyxo detained her; and to puniſh her as being the cauſe of a war in which Tlepolemus had periſhed, ſhe ordered her to be hanged on a tree by her female ſervants, diſguiſed in the habit of Furies.

POMACEÆ, (*pomum* "an apple,") the name of the 36th order in Linnæus's Fragments of a Natural Method, the genera of which have a pulpy eſculent fruit of the apple, berry, and cherry kind. See BOTANY, Sect. vi. p. 465.

POMATUM, an unguent generally uſed in dreſſing the hair. It is alſo uſed as a medicine. See PHARMACY, nº 636, &c.

POMEGRANATE. See PUNICA.

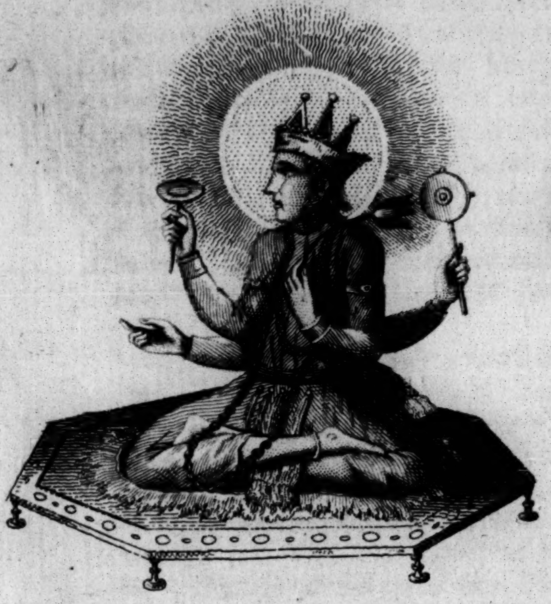
POMERANIA, a province of Germany, in the circle of Upper Saxony, with the title of a duchy. It is bounded on the north by the Baltic Sea, on the eaſt by Pruſſia and Poland, on the ſouth by the marquiſate of Brandenburg, and on the weſt by the duchy of Mecklenburg; and is about 250 miles in length, and in ſome places 75 miles and in others 50 in breadth. It is watered by ſeveral rivers, the moſt conſiderable of which are the Oder, the Pene, the Rega, the Perſant, the Wipper, the Stolp, the Lupo, and the Lobo. The air is cold; but the ſoil abounds in paſtures, and produces corn, of which a great deal is exported. It is a flat country; containing many lakes, woods, and foreſts, and has ſeveral good harbours. It is divided into the Hither and Farther Pomerania, and the territories of the kings of Sweden and Pruſſia in this duchy are divided by the river Pene.

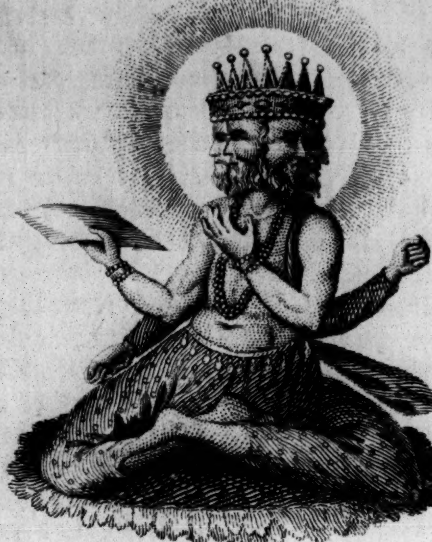
POMET (Peter), an able druggiſt at Paris, was born in 1658. He collected at a great expence from all countries drugs of every kind, and rendered himſelf celebrated by his book entitled *Hiſtoire Generale des Drogues*

POLYTHEISM. Plate CCCCXI.

INDIAN GODS.

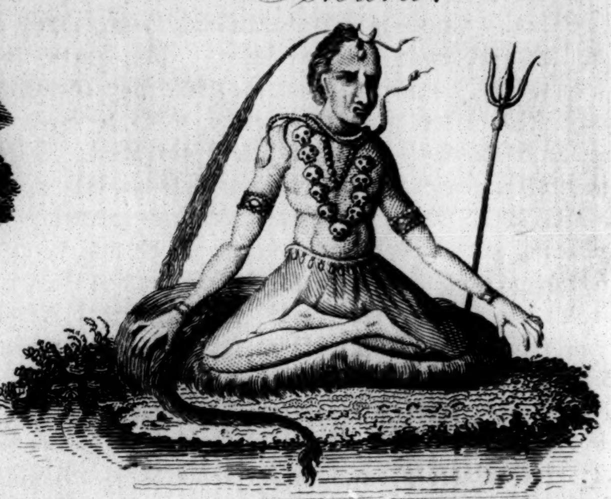
Vishnu



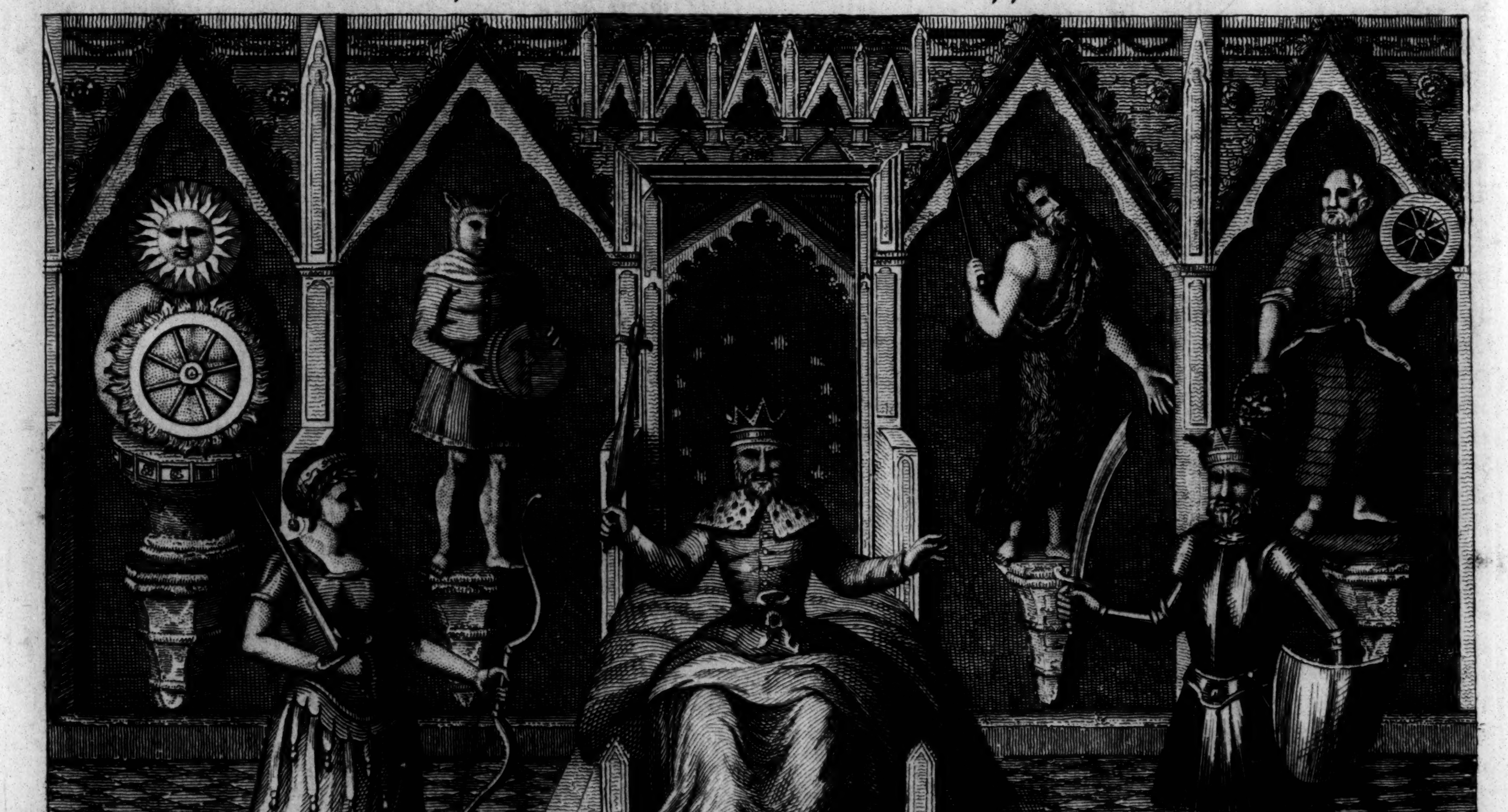


Brahma.

Iswara.



The Principal IDOLS of the Saxons worshipped in Britain.



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BRITISH MUSEUM

Drogues, which is the moſt complete book on the ſubject that has yet been printed. He gave demonſtrations with reſpect to his drugs in the king's garden, and a catalogue of all the drugs contained in his work, with a liſt of all the rarities of his cabinet, which he propoſed to publiſh by ſubſcription; but was prevented by his death, which happened in 1699, upon the very day when the patent for a penſion granted him by Louis XIV. was made out.

POMFRET (John), an Engliſh poet, ſon of the rector of Luton in Bedfordſhire, was born in 1667, and educated at Cambridge; after which he took orders, and was preſented to the living of Malden in Bedfordſhire. About 1703 he went to London for inſtitution to a larger and very conſiderable living; but was ſtopped ſome time by Compton, then biſhop of London, on account of theſe four lines of his poem, entitled the Choice:

> " And as I near approach'd the verge of life,
> Some kind relation (for I'd have no wife)
> Should take upon him all my worldly care,
> While I did for a better ſtate prepare."

The parentheſes in theſe lines were ſo maliciouſly repreſented, that the good biſhop was made to believe that Pomfret preferred a miſtreſs to a wife. But he was ſoon convinced that this repreſentation was the mere effect of malice, as Pomfret at that time was actually married. The oppoſition, however, which his ſlanderers had made to him had its effect; for, being by this obliged to ſtay in London longer than he intended, he catched the ſmallpox, and died of it, aged 35.

He publiſhed a volume of his poems in 1699, with a very modeſt and ſenſible preface. Two pieces of his were publiſhed after his death by his friend Philalethes; one intitled Reaſon, and written in 1700, when the diſputes about the Trinity ran high; the other *Dies Noviſſima*, or the "Laſt Epiphany," a Pindaric ode. His verſification is not unmuſical; but there is not the force in his writings which is neceſſary to conſtitute a poet. A diſſenting teacher of his name, and who publiſhed ſome rhimes upon ſpiritual ſubjects, occaſioned fanaticiſm to be imputed to him; but his friend Philalethes has juſtly cleared him from the imputation. Pomfret had a very ſtrong mixture of devotion in him, but no fanaticiſm.

"The Choice (ſays Dr Johnſon) exhibits a ſyſtem of life adapted to common notions, and equal to common expectations; ſuch a ſtate as affords plenty and tranquillity, without excluſion of intellectual pleaſures. Perhaps no compoſition in our language has been oftener peruſed than Pomfret's Choice. In his other poems there is an eaſy volubility; the pleaſure of ſmooth metre is afforded to the ear, and the mind is not oppreſſed with ponderous, or entangled with intricate, ſentiment. He pleaſes many; and he who pleaſes many muſt have merit."

POMME, or POMMETTE, in heraldry, is a croſs with one or more balls or knobs at each of the ends.

POMMEL, or PUMMEL, in the manege, a piece of braſs or other matter at the top and in the middle of the ſaddle-bow.

POMMERCULLIA, in botany: A genus of the monogynia order, belonging to the triandria claſs of plants; and in the natural method ranking under the 4th order, *Gramina*. The calyx is bivalved, and ſhaped like a top; the valvula quadrifid, and bearded on the back. The corolla has two unequal valves; the filaments three, with long pointed antheræ; the ſtyle ſimple. The whole flower forms itſelf into a ſharp point, and the corolla ſerves as a covering to the ſeed, which is long, clear, and ſmooth. There is only one ſpecies, viz, the Dianthoides.

POMŒRIUM, in Roman antiquity, was, according to Livy, that ſpace of ground, both within and without the walls, which the augurs, at the firſt building of cities, ſolemnly conſecrated, and on which no edifices were allowed to be raiſed. Plutarch gives this account of the ceremony of drawing the pomœrium: "They dug a trench, and threw into it the firſt-fruits of all things, either good by cuſtom, or neceſſary by nature; and every man taking a ſmall turf of earth of the country from whence he came, they caſt them in promiſcuouſly. Then making this trench their centre, they deſcribed the city in a circle round it. After this, the founder yoking a bull and a cow together, ploughed a deep furrow, with a brazen ploughſhare, round the bounds. The attendants took care that all the clods fell inwards, *i. e.* toward the city. This furrow they called *pomœrium*, and built the wall upon it."—Plutarch, in this account, is to be underſtood as ſpeaking of Rome.

POMOERIUM Proferre, ſignifies to extend or enlarge a city, which could not be done by any, but thoſe who had taken away ſome part of an enemy's country in war. But this qualification was ſometimes diſpenſed with. *Pomœrium* is *quaſi pone mœnia*, "behind the walls."

POMONA, in fabulous hiſtory, the tutelar deity of orchards and fruit-trees. See VERTUMNUS.

POMPEII (anc. geog.), a town of Campania near Herculaneum, and deſtroyed along with it by the great eruption of Veſuvius in the time of Titus. See HERCULANEUM. It is about 15 miles from Naples, and ſix or ſeven from Portici—So much has been ſaid and written on the diſcovery of this place, as makes it unneceſſary for us to ſay much: we ſhall therefore only give a ſhort extract on the ſubject from an anonymous work lately publiſhed, apparently of conſiderable merit. "On entering the city (ſays our author *), the firſt object is a pretty ſquare, with arcades, after the preſent manner of Italy. This was, as it is imagined, the quarter of the ſoldiers; numbers of military weapons being found here.

*Comparative Sketch of England and Italy, with Diſquiſitions on National Advantages.

"A narrow, but long ſtreet, with ſeveral ſhops on each ſide, is now perfectly cleanſed from its rubbiſh, and in good preſervation. Each houſe has a court. In ſome of them are paintings all freſco, principally in chiaroſcuro; and their colours not in the leaſt injured by time. The few colours which the ancients knew were extracted only from minerals; and this may be a ſufficient reaſon for their freſhneſs. The ſtreet is paved with irregular ſtones of a foot and half or two feet long, like the Appian way.

"In diſcovering this city, it was at firſt doubted whether it were actually Pompeii: but the name inſcribed over the gateway put it beyond all doubt. The ſkeletons found were innumerable. It is ſaid that many had ſpades in their hands, endeavouring, probably at firſt, to clear away the torrent of aſhes with which they were deluged. Indeed the ſatisfaction which is felt at the view of ancient habitations, is much allayed by inevitable reflections on this frightful ſcene of deſolation, though at the diſtance of ſo many centuries.

"An ancient villa is alſo ſeen entire at a little diſtance feom Pompeii. The houſe is really elegant and ſpacious, but only two ſtories high. The pavement of the chambers is compoſed of teſſelated marble, and, when poliſhed, diſplays the deſign perfectly well.—There is ſome at the muſeum of Portici brought from this place, which the eye would really miſtake for painting. Under the houſe is a fine triangular cellar, of which each part is 100 feet long, well filled with amphoræ. The ſkeletons of 29 perſons were found here, ſuppoſed to have fled to it for ſafety. Each houſe is filled with aſhes: they have almoſt penetrated through every crevice; and it is incredible how ſuch a volume of them could have been thrown out by Veſuvius with ſufficient force to have reached ſo far." See Swinburne's *Travels in the Two Sicilies*, vol. 2. p. 98, &c.; Lady Miller's *Letters*, or *De La Lande;* Captain Sutherland's *Tour up the Straits, from Gibraltar to Conſtantinople*, p. 75. &c.; Dr Smith's *Sketch of a Tour on the Continent*, in 1786 and 1787, vol. 2. p. 118, &c.; and Watkins's *Tour through Swiſſerland, Italy*, &c.

POMPEY the GREAT, (Cneius Pompeius Magnus), the renowned rival of Julius Cæſar. Being defeated by him at the battle of Pharſalia, owing to the defection of his cavalry, he fled to Egypt by ſea, where he was baſely aſſaſſinated by order of Theodotus, prime miniſter to Ptolomy the Younger, then a minor, 48 B. C*.

*See Rome

POMPEYS (Cneius and Sextus), his ſons, commanded a powerful army when they loſt their illuſtrious father. Julius Cæſar purſued them into Spain, and defeated them at the battle of Munda, in which Cneius was ſlain, 45 B. C. Sextus made himſelf maſter of Sicily; but being defeated in the celebrated naval engagement at Actium by Auguſtus and Lepidus, he fled to Aſia with only 7 ſhips, the remains of his fleet, which conſiſted of more than 350; and from thence, unable to continue the war, he was obliged to retire to Leſbos, where renewing the war by raiſing an army, and ſeizing on ſome conſiderable cities, Marcus Titius, in the intereſt of Marc Antony, gave him battle, defeated him, took him priſoner and baſely put him to death, 35 B. C. See ROME.

POMPEY's-Pillar. See ALEXANDRIA, p. 393.

POMPILUS, in ichthyology, a ſpecies of CORYPHOENA.

POMPONATIUS (Peter), an eminent Italian philoſopher, was born at Mantua in 1462. He was of ſo ſmall a ſtature that he was little better than a dwarf; yet he poſſeſſed an exalted genius, and was conſidered as one of the greateſt philoſophers of the age in which he lived. He taught philoſophy, firſt at Padua and afterwards at Bologna, with the higheſt reputation. He had frequent diſputations with the celebrated Achillini, whoſe puzzling objections would have confounded him, had it not been for his ſkill in parrying them by ſome joke. His book *De Immortalitate Animæ*, publiſhed in 1516, made a great noiſe. He maintained, that the immortality of the ſoul could not be proved by philoſophical reaſons; but ſolemnly declared his belief of it as an article of faith. This precaution did not, however, ſave him; many adverſaries roſe up againſt him, who did not ſcruple to treat him as an atheiſt; and the monks procured his book, although he wrote ſeveral apologies for it, to be burnt at Venice. His book upon Incantations was alſo thought very dangerous. He ſhows in it, that he believed nothing of magic and ſorcery; and he lays a prodigious ſtreſs on occult virtues in certain men, by which they produced miraculous effects. He gives a great many examples of this; but his adverſaries do not admit them to be true, or free from magic.—Paul Jovius ſays, that he died in 1525, in his grand climacteric. He was three times married; and had but one daughter, to whom he left a large ſum of money. He uſed to apply himſelf to the ſolution of difficulties ſo very intenſely, that he frequently forgot to eat, drink, ſleep, and perform the ordinary functions of nature: nay, it made him almoſt diſtracted, and a laughing-ſtock to every one, as he himſelf tells us.

POMPONIUS MELA. See MELA.

POMUM, an APPLE; a ſpecies of ſeed-veſſel, compoſed of a ſucculent fleſhy pulp; in the middle of which is generally found a membranous capſule, with a number of cells, or cavities, for containing the ſeeds. Seed-veſſels of this kind have no external opening or valve. At the end oppoſite to the foot-ſtalk is frequently a ſmall cavity, called by the gardeners the *eye of the fruit*, and by botaniſts *umbilicus*, the "navel," from its fancied reſemblance to the navel in animals. Gourd, cucumber, melon, pomegranate, pear, and apple, furniſh inſtances of the fruit or ſeed-veſſel in queſtion.

POND, or *FISH-Pond*. See *FISH-Ponds*.

POND, is a ſmall pool or lake of water from whence no ſtream iſſues. In the *Tranſactions of the Society inſtituted at London for the Encouragement of Arts, Manufactures, and Commerce*, vol. viii. and printed in the year 1790, there is a ſhort account of a machine for draining ponds without diſturbing the mud. It was communicated to the ſociety, together with a drawing and model of the machine, by Lieutenant-colonel Danſey. The model was made from the deſcription of a machine uſed by a gentleman near Taunton for many years before, for ſupplying a caſcade in his pleaſure-grounds.—The colonel's regiment was then lying at Windſor; and thinking that the invention might be uſeful to ſupply the grand caſcade at Virginia-water, he made the model, and preſented it to the king, who was graciouſly pleaſed to approve of it. In conſequence of which, by his majeſty's deſire, a penſtock on that principle was conſtructed from the model at one of the ponds in the neighbourhood.—The colonel thinks the machine may be uſeful in the hands of men of ſcience, and applicable to ſilk, cotton, and other mills, where a ſteady and uniform velocity of water is wanted; which might be regulated at pleaſure, occaſioning no current to diſturb the mud or fiſh, as the ſtream conſtantly runs from the ſurface. He ſays he has often made the experiment by the model in a tub of water.

Of this machine we have given an engraving, taken from the abovementioned Tranſactions; and we ſhall now add the deſcription which accompanies the plate in that work.

Plate CCCCXIII

In figure 1. A is the pipe, loaded with a rim of lead, of ſuch weight as ſerves to ſink it below the ſurface of the water. B is the diſcharging pipe, laid through the bank HI. C is the joint on which the pipe A turns its form, which is ſhown fig. 2. D is the ball or float, which, ſwimming on the ſurface of the pond, prevents the pipe A from deſcending deeper than the length of the chain by which they are connected. E is a chain winding on the windlaſs F, and ſerving to raiſe the tube A above the ſurface of the water, when the machinery is not in uſe. G is a ſtage. HI is the bank, repreſented as if cut through at I, to ſhow the tube B lying within it. K is a poſt to receive the tube A when lowered, and to prevent its ſinking in the mud. In figure 2. A is a caſt cylinder, with a plate or cheek, B, which is faſtened to the timber of the tube on one ſide, but not on the other, as the part of the cylinder C turns in the hollow of the wooden tube when it is immerged. A piece of ſtrong ſole leather is put inſide the braſs-plate B, to prevent leaking.

Pond-Weed, in botany. See POTAMOGETON.

PONDICHERRY, is a large town of Aſia, in the peninſula on this ſide the Ganges, and on the coaſt of Coromandel. Its ſituation is low, and the ſhips anchor about a mile and a half from it; nor can the boats or canoes come nearer it than a muſket-ſhot, on account of the breakers, ſo that the blacks come in flat-bottomed boats to carry the men and merchandiſes to the fleet. The fort is 200 paces from the ſea, and very irregular; built with bricks, and covered with fine plaſter, reſembling white marble. The huts of the blacks lie here and there, and the walls are of bamboos mixed with the branches of trees. The French are greatly addicted to women, from whom they catch diſeaſes that render them pale, livid, and meagre, with a frightful aſpect. However, ſeveral of the French are married to a ſort of Portugueſe women, who are of a mixed breed, being a kind of Mulattoes. The country about it is barren, and conſequently moſt of their proviſions are brought from other places. Their trade conſiſts of cotton-cloth, ſilks, pepper, ſaltpetre, and other merchandiſes that are brought from Bengal. With regard to the religion of the natives, the moſt numerous are the Gentoos; but there are Mahometans or Moors who hold a great many ridiculous opinions. The Gentoos are of different ſects, and that of the Brahmins are prieſts. The cuſtom of women burning themſelves with the bodies of their dead huſbands was very common, but of late much diſcountenanced. The ſlaves or ſervants are very numerous, and their chief food is rice. This place was taken, and the fortifications demoliſhed, by Colonel Coote; it was reſtored to the French by the peace of 1763; and was retaken in the beginning of the preſent war with the French republic. It is 60 miles ſouth of Fort St George. E. Long. 79. 58. N. Lat. 11. 42.

PONDICO, an iſland of the Archipelago, lying on the gulph of Zitun, near the coaſt of Negropont. It is ſmall and uninhabited, as well as two others that lie near it.

PONG-HOU *Iſles*, in the province of Fo-kien in China, form an archipelago between the port of Emouy and the iſland of Formoſa. A Chineſe garriſon is kept here, with one of thoſe mandarins who are called *literati*, whoſe principal employment is to watch the trading veſſels which paſs from China to Formoſa, or from Formoſa to China.

As theſe iſlands are only ſand-banks or rocks, the inhabitants are obliged to import every neceſſary of life; neither ſhrubs nor buſhes are ſeen upon them; all their ornament conſiſts of one ſolitary tree. The harbour is good, and ſheltered from every wind; it has from 20 to 25 feet depth of water. Although it is an uncultivated and uninhabited iſland, it is abſolutely neceſſary for the preſervation of Formoſa, which has no port capable of receiving veſſels that draw above 8 feet of water.

PONIARD, a little pointed dagger, very ſharp edged; borne in the hand, or at the girdle, or hid in the pocket. The word is formed from the French *poignard*, and that from *poignnée*, "handful."—The poniard was anciently of very great uſe; but it is now in a good meaſure ſet aſide, except among aſſaſſins.—Sword and poniard were the ancient arms of dueliſts; and are ſaid to continue ſtill ſo among the Spaniards. The practice of ſword and poniard ſtill make a part of the exerciſe taught by the maſters of defence.

PONS, a town of France, in Saintonge, very famous in the time of the Huguenots. It is ſeated on a hill, near the river Suigne, 10 miles from Saintes. W. Long. 0. 30. N. Lat. 45. 36.

PONT-DU-GARD, is a bridge of France, in Lower Languedoc, built over the river Gardon, which ſerved for an aqueduct. It is a very remarkable and a moſt magnificent work, and was raiſed by the ancient Romans. It conſiſts of three bridges, one above another; the uppermoſt of which was the aqueduct, to convey water to the city of Niſmes, which is eight miles to the ſouth. They are altogether 192 feet high, and the uppermoſt 580 feet long. They are conſtructed between two rocks. E. Long. 4. 26. N. Lat. 43. 58.

PONTEDERIA, in botany: A genus of the monogynia order, belonging to the hexandria claſs of plants; and in the natural method ranking under the ſixth order, *Enſatæ*. The corolla is monopetalous, ſexfid, bilabiate; there are three ſtamina inſerted into the top, and three into the tube of the corolla; the capſule is bilocular.

PONTEFRACT, or POMFRET, a town of the Weſt Riding of Yorkſhire in England, ſituated on the river Are. It is ſaid to take its name from a broken bridge, which is ſuppoſed to have been laid anciently over that marſhy ſpot called the *Waſh*. Here are the ruins of a noble old caſtle, were Richard II. was barbarouſly murdered, and two of Edward V.'s uncles. The collegiate chapel of St Clement, which had a dean, three prebendaries, &c. is ſtill diſtinguiſhable in it. This town has a good market, and fairs for horſes, ſheep, and other cattle. It is a corporation, governed by a mayor, recorder, aldermen, and burgeſſes and gives title of earl to the family of Fermor. In the reign of Queen Elizabeth, 200 l. was left by George Talbot, earl of Shrewſbury, to be lent for ever, at 5 l. a time, on proper ſecurity, for three years, to the poor artificers of the town; and Thomas Wentworth, Eſq: anceſtor to the marquis of Rockingham, left 200l. to the charity-ſcool. A branch of the great Roman military way called *Erminſtreet*, which paſſed from Lincoln to York, may be traced betwixt town and Doncaſter. The adjacent country yields plenty of limeſtone, together with liquorice and ſkirrets, W. Long. 1. 5. N. Lat. 53. 42.

PONTIFEX, Pontiff, or *High-prieſt*, a perſon who has the ſuperintendance and direction of divine worſhip as the offering of ſacrifices and other religious ſolemnities. The Romans had a college of pontiffs; and over theſe a ſovereign pontiff, or pontifex maximus, inſtituted by Numa, whoſe function it was to preſcribe the ceremonies each god was to be worſhipped withal, compoſe the rituals, direct the veſtals, and for a good while to perform the buſineſs of augury, till, on ſome ſuperſtitious occaſion, he was prohibited intermeddling therewith. The office of the college of pontiffs was to aſſiſt the high-prieſt in giving judgment in all caſes relating to religion, inquiring into the lives and manners of the inferior prieſts, and puniſhing them if they ſaw occaſion, &c. The Jews too had their pontiffs; and among the Romaniſts, the pope is ſtill ſtyled the *ſovereign pontiff*.

PONTIFICATE, is uſed for the ſtate or dignity of a pontiff or high-prieſt; but more particularly in modern writers for the reign of a pope.

PONTIUS (Pilate.) See Pilate.

PONTON, or Pontoon, in war, a kind of flat bottomed boat, whoſe carcaſe of wood is lined within and without with tin: they ſerve to lay bridges over rivers for the artillery and army to march over. The French pontoons, and thoſe of moſt other powers, are made of copper on the outſide: though theſe coſt more at firſt, yet they laſt much longer than thoſe of tin; and when worn out, the copper ſells nearly for as much as it coſt at firſt; but when ours are rendered uſeleſs, they ſell for nothing. Our pontoons are 21 feet long, five feet broad, and depth within two feet 1.5 inches.

Pontoon-Carriage, is made with two wheels only, and two long ſide-pieces, whoſe fore-ends are ſupported by a limber; and ſerves to carry the pontoon, boards, croſs-timbers, anchors, and every other thing neceſſary for making a bridge.

Pontoon-Bridge, is made of pontoons ſlipped into the water, and placed about five or ſix feet aſunder; each faſtened with an anchor, when the river has a ſtrong current; or to a ſtrong rope that goes acroſs the river, running through the rings of the pontoons. Each boat has an anchor, cable, baulks, and cheſts. The baulks are about five or ſix inches ſquare, and 21 feet long. The cheſts are boards joined together by wooden bars, about three feet broad and 12 feet long. The baulks are laid acroſs the pontoons at ſome diſtance from one another, and the cheſts upon them joined cloſe; which makes a bridge in a very ſhort time, capable of ſupporting any weight.

PONT St Esprit, is a town of France, in Languedoc, in the dioceſe of Uſez. It is ſeated on the river Rhone, over which is one of the fineſt bridges in France. It is 840 yards long, and conſiſts of 26 arches. Each pier is pierced with an aperture, in order to facilitate the paſſage of the water where the river is high. The town is large, but the ſtreets are narrow and ill-built. It formerly contained ſeveral churches and convents. It is 17 miles ſouth of Viviers, and 55 north-eaſt of Montpelier. E. Long. 4. 46. N. Lat. 44. 13.

1 Etymology of the name.

PONTUS, the name of an ancient kingdom of Aſia, originally a part of Cappadocia; bounded on the eaſt by Colchis, on the weſt by the river Halys, on the north by the Euxine Sea, and on the ſouth by Armenia Minor. Some derive the name of Pontus from the neighbouring ſea, commonly called by the Latins *Pontus Euxinus*; others from an ancient king named *Pontus*, who imparted his name both to the country and the ſea; but Bochart deduces it from the Phœnician word *botno*, ſignifying a filberd, as if that nut abounded remarkably in this place. But this derivation ſeems to be very far fetched; and the common opinion that the country derived its name from the ſea, ſeems by far the moſt probable. The kingdom was divided into three parts; the firſt, named *Pontus Gallaticus*, extending from the river Halys to the Thermodon; the ſecond, named *Pontus Polemonaicus*, extended from the Thermodon to the borders of *Pontus Cappadocicus*; and this laſt extended from Pontus Polemonaicus to Colchis, having Armenia Minor and the upper ſtream of the Euphrates for its ſouthern boundary.

2 Artabazes the firſt king.

It is commonly believed, that the firſt inhabitants of Pontus were deſcended from Tubal; but in proceſs of time mixed with Cappadocians, Paphlagonians, and other foreign nations, beſides many Greek Colonies which ſettled in thoſe parts, and maintained their liberty till the time of Mithridates the Great and Pharnaces. The firſt king of this country whom we find mentioned in hiſtory is Artabazes, who had the crown beſtowed on him by Darius (a) Hyſtaſpes. The next was Rhodobates, who reigned in the time of Darius Nothus. After him came Mithridates, who, refuſing to pay the uſual tribute to the Perſians, was defeated by Artaxerxes Mnemon; but a peace was ſoon after concluded by the mediation of Tiſſaphernes. Beſides this, we hear nothing of him farther than that he was treacherouſly taken priſoner by Clearchus afterwards tyrant of Heraclea, and obliged to pay a large ſum for his ranſom.

3 Mithridates I.

Mithridates I. was ſucceeded by Ariobarzanes, who being appointed by Artaxerxes governor of Lydia, Ionia, and Phrygia, employed the forces that were under his care in the extending of his own dominions, and ſubduing thoſe of his natural prince. The king of Perſia ſent one Autophrodates againſt him; but Ariobarzanes, having with great promiſes prevailed on Ageſilaus and Timothæus the Athenian to come to his aſſiſtance, obliged Autophrodates to retire. He then rewarded Ageſilaus with a great ſum of money, and, beſtowed on Timothæus the cities of Seſtos and Abydos, which he had lately taken from the Perſians. He uſed his utmoſt endeavours to reconcile the Lacedemonians and Thebans; but not being able to bring the latter to any reaſonable terms, he aſſiſted the Lacedemonians with vaſt ſums of money. The Athenians ſhowed ſo much reſpect for this prince, that they not only made him free of their city, but granted both him and his children whatever they aſked of them. He was murdered in the 28th year of his reign by one Mithridates, whom authors ſuppoſe to have been his ſon. This happened at the time that Alexander the Great invaded Aſia, ſo that Pontus for a time fell under the power of the Macedonians.

(a) This country, together, with the adjacent provinces, was in different periods under the dominion of the Aſſyrians, Medes, and Perſians; the laſt of whom divided Cappadocia into ſatrapies or governments, and beſtowed that diviſion which was afterwards called *Pontus* on one of the anceſtors of Mithridates. This regulation was effected in the reign of Darius the ſon of Hyſtaſpes, and has been regarded as the date of the kingdom.

4 Ariobarzanes ſhakes off the Macedonian yoke.

In the reign of Antigonus, Mithridates the ſon of Ariobarzanes ſhook off the Macedonian yoke; the particulars of which event are related as follow. Antigonus having dreamed that he had a field in which gold grew after the manner of corn, and that Mithridates cut it down and carried it into Pontus, began to be very jealous of him, and ordered him to be put to death privately. But Mithridates, having got notice of the king's intention, withdrew into Paphlagonia, attended only by ſix horſemen. Here, being joined by many others, he poſſeſſed himſelf of Ciniatum, a ſtrong hold ſituated near mount Olgaſys; from whence, as his army continually increaſed, he made an irruption into Cappadocia; and having driven the commanders of Antigonus from that part which borders upon Pontus, he entered his paternal kingdom, which, in ſpite of the utmoſt efforts of Antigonus, he held for the ſpace of 26 years, and tranſmitted to his poſterity.

Under the reigns of Mithridates III. Ariobarzanes II. and Mithridates IV. the immediate ſucceſſors of Mithridates II. nothing remarkable happened. But Mithridates V. made war on the inhabitants of Sinope, a city on the coaſt of Paphlagonia. He made himſelf maſter of all the adjacent places; but finding the whole peninſula, on which Sinope itſelf ſtood, well fortified and garriſoned, not only by the inhabitants, but by their allies the Rhodians, he abandoned the enterpriſe. He afterwards proved a great friend to the Rdodians, and aſſiſted them with money to repair the loſſes they had ſuſtained by an earthquake. He entered alſo into a ſtrict alliance with Antiochus the Great, who married one of his daughters named *Laodice*.

5 Pharnaces I. differs with the Romans.

After the death of Mithridates V. his ſon Pharnaces I. attacking the city of Sinope, unexpectedly took it by ſtorm. On this the Rhodians ſent ambaſſadors to Rome, complaining of the behaviour of the king of Pontus; but Pharnaces was ſo far from being intimidated by their threats, that he invaded the territories of Eumenes their great ally. The latter ſent ambaſſadors to Rome, and entered into an alliance with Ariarathes king of Cappadocia. Pharnaces, in his turn, ſent ambaſſadors to Rome, complaining of Eumenes and Ariarathes; upon which ſome Romans were ſent into Aſia to inquire into the ſtate of matters. Theſe found Eumenes and his aſſociates willing to accomodate the difference, but Pharnaces in a quite oppoſite diſpoſition, which they accordingly reported at Rome.

6 Concludes a moſt diſadvantageous peace,

In the mean time a war was commenced between Eumenes and Pharnaces; but the latter, being diſappointed of aſſiſtance from Seleucus king of Syria, whom the Romans would not allow to join him, was at laſt forced to ſue for peace; which was granted him upon the following conditions: That he ſhould forthwith withdraw his forces from Galatia, and diſannul all engagements and alliances with the inhabitants of that country; that he ſhould in like manner evacuate Paphlagonia, and ſend back ſuch as he had from thence carried into ſlavery; that he ſhould reſtore to Ariarathes all the places which he had taken during the war, the hoſtages of both kings, all their priſoners without ranſom, and moreover ſhould deliver up to them ſuch of their ſubjects as from the firſt breaking out of the war had fled to him; that he ſhould return to Morzias, a petty king in theſe parts, and to Ariarathes, 900 talents which he had ſeized in the war, and pay down 300 more to Eumenes as a fine for invading his dominions without provocation. Mithridates, king of Armenia, having in this war joined Pharnaces, was, by the articles of the treaty, obliged to pay 300 talents to Ariarathes for having aſſiſted his enemy contrary to an alliance at that time ſubſiſting between them. Soon after Pharnaces died, and left the kingdom to his ſon Mithridates VI. more weakened by this peace than by the moſt deſtructive war.

7 His ſon enters into alliance with the Romans.

The new king entered into an alliance with the Romans, and proved ſuch a faithful friend, that he was rewarded by the ſenate with Phrygia Major, and honoured with the title of the friend and ally of the people of Rome. After a long and proſperous reign, he was murdered by ſome of his intimate acquaintance, and was ſucceeded by his ſon Mithridates VII. ſurnamed the *Great*.

8 Mithridates the Great a cruel prince.

The new prince, though not exceeding 13 years of age, began his reign with moſt inhuman acts of cruelty to his mother and neareſt relations. His father, by his laſt will, had appointed him and his mother joint heirs to the kingdom; but he, claiming the whole, threw her into priſon, where ſhe ſoon died through the hard uſage ſhe met with. Thoſe to whom the care of his education was committed, obſerving him to be of a cruel and unruly temper, made various attempts on his life, but could never effect their deſign, as the king was always on his guard, and armed, in that tender age, againſt all kind of treachery, without ſhowing the leaſt diffidence.

7 His extraordinary qualities.

In his youth Mithridates took care to inure himſelf to hardſhips, paſſing whole months in the open air, employed in the exerciſe of hunting, and often taking his reſt amidſt the frozen ſnow. When he came of age, he married his ſiſter named *Laodice*, by whom he had a ſon named *Pharnaces*. After this he took a journey through many different kingdoms of Aſia, having nothing leſs in view than the whole continent. He learned their different languages, of which he is ſaid to have ſpoken 22; took an eſtimate of their ſtrength; and above all viewed narrowly their ſtrong holds and fortified towns. In this journey he ſpent three years; during which time, a report being ſpread abroad that he was dead, his wife Laodice had a criminal converſation with one of the lords of her court, and had a ſon by him. When her huſband returned, ſhe preſented him with a poiſoned bowl; but Mithridates had accuſtomed himſelf to take poiſon from his infancy, ſo that it had now no other effect than to haſten the deſtruction of his wife, which very ſoon took place, together with all thoſe who had been any way acceſſory to her diſloyalty and incontinence.

The king now began to put in execution his ſchemes of conqueſt. However, he certainly took the wrong method by attacking firſt thoſe nations which were immediately under the protection of Rome, and thus at once provoking that powerful people to fall upon him.

10 Conquers ſeveral countries.

He began with Paphlagonia, which the Romans had declared a free ſtate. This country he eaſily reduced, and divided between himſelf and Nicomedes king of Bithynia, at that time his ally. The Romans remonſtrated; but Mithridates, inſtead of paying any regard to their remonſtrances, invaded Galatia, which was immediately under their protection. This he alſo reduced, and then turned his eyes on Cappadocia. But as the kingdom of Cappadocia was at that time held by Ariarathes, who was a great favourite of the Romans, and married to the ſiſter of Mithridates, the latter hired an aſſaſſin to diſpatch Ariarathes, after which he thought he might ſucceed better in his deſigns.

11 Cauſes the king of Cappadocia to be murdered.

After the death of Arinrathes, Cappadocia was invaded by Nicomedes king of Bithynia, who drove out the ſon, and married the widow of Ariarathes. This gave Mithridates a plauſible pretence for invading Cappadocia; which he inſtantly did, and drove Nicomedes quite out of the country. Thus Mithridates gained conſiderable reputation, not only as a warrior, but as a juſt and good-natured prince; for as it was not known that he had any hand in the murder of Ariarathes, every one imagined that he had undertaken the war againſt Nicomedes, merely to revenge the quarrel of his nephew, and to reſtore him to his right. To keep up the farce a little longer, Mithridates actually withdrew his troops out of the country, and left the young prince maſter of the kingdom. In a ſhort time, however, he began to preſs the young king of Cappadocia to recal the aſſaſſin Gordius, who had murdered his father: but this the king of Cappadocia refuſed with indignation; and Mithridates, being determined on a quarrel at all events, took the field with an army of 80,000 foot, 10,000 horſe, and 600 chariots armed with ſcythes.

12 Aſſaſſinates his own nephew.

With this force he imagined he ſhould carry all before him: but finding the king of Cappadocia ready to oppoſe him with a force no way inferior to his own, he had recourſe to treachery; and inviting his nephew to a conference, ſtabbed him, in the ſight of both armies, with a dagger which he had concealed in the plaits of his garment. This barbarous and unexpected piece of treachery had ſuch an effect on the Cappadocians that they threw down their arms, and ſuffered Mithridates, without oppoſition, to ſeize upon all their ſtrong holds. He reſigned the kingdom, however, to his ſon, a child of eight years of age. The care of the young prince, and of the whole kingdom, he committed to Gordius; but the Cappadocians, diſdaining to be ruled by ſuch a ſcandalous aſſaſſin, placed on the throne the brother of Ariarathes, who had kept himſelf concealed in ſome part of Aſia. His reign, however, was of ſhort duration; he being ſoon after driven out by Mithridates, and the Cappadocians again reduced. The unhappy prince died of grief; and in him ended the family of Pharnaces, who had ruled Cappadocia from the time of Cyrus the Great.

13 Nicomedes king of Bithynia attempts to deceive the Romans.

Nicomedes, king of Bythynia, being now greatly afraid of Mithridates, and ſuppoſing that his own dominions would next fall a prey to the ambitious conqueror, ſuborned a youth of a comely and majeſtic aſpect to pretend that he was a third ſon of Ariarathes, to go to Rome, and demand the kingdom of Cappadocia as his juſt right. He was received by the ſenate with the greateſt kindneſs, and Laodice the wife of Nicomedes even confirmed the deceit by her oath.

14 The deceit expoſed by Mithridates.

But in the mean time Mithridates having got intelligence of the plot, ſent notice of it by Gordius to the Romans, ſo that the impoſture was ſoon known at Rome alſo. The conſequence of this was, that the ſenate commanded Mithridates to relinquiſh Cappadocia, and Nicomedes that part of Paphlagonia which he poſſeſſed; declaring both theſe countries free. The Cappadocians proteſted that they could not live without a king; upon which they were allowed to chooſe one of their own nation. Mithridates uſed all his intereſt in favour of Gordius; but he being excluded by the Romans, one Ariobarzanes was choſen by the majority of votes.

15 Ariobarzanes ſettled on the throne of Cappadocia by the Romans, but driven out by Mithridates,

To enforce this election, Sylla was ſent into Cappadocia. He had the character of an ambaſſador, but the real intent of his coming was to diſappoint the ambitious deſigns of Mithridates. With an handful of forces he defeated a numerous army of Cappadocians and Armenians commanded by Gordius, and ſettled Ariobarzanes on the throne. But no ſooner was Sylla gone than Mithridates ſtirred up Tigranes king of Armenia againſt Ariobarzanes, who, without making any reſiſtance, fled to Rome, and Tigranes reſtored the kingdom to Ariarathes the ſon of Mithridates. At the ſame time died the king of Bithynia; upon which Mithridates immediately invaded that country, and drove out Nicomedes the natural ſon of the late king. But the expelled prince, having fled to Rome, and being aſſiſted by that powerful republic, the king of Pontus was ſoon obliged to abandon Bithynia and Cappadocia.

16 Who engages in a war with the Romans,

The Romans now being exceedingly jealous of the power and ambition of Mithridates, reſolved to humble him at all events. For this purpoſe they ſent ambaſſadors to the kings of Bithynia and Cappadocia, deſiring them to make frequent inroads into the neighbouring territories of Mithridates, and behave there as they pleaſed; aſſuring them of powerful aſſiſtance in caſe they ſhould have occaſion. Ariobarzanes could not by any means be induced to provoke ſo powerful a neighbour; but Nicomedes being induced, partly by promiſes and partly by menaces, to comply, entered Pontus, where he laid waſte whole provinces with fire and ſword. Mithridates complained to the Roman legates: but they replied, that he himſelf had been the firſt aggreſſor; that Nicomedes had only paid him in his own coin, and that they would not allow him to hurt their friend and ally.

17 Defeats Ariobarzanes and Altinius,

Upon this Mithridates, entering Cappadocia with a numerous army, put to flight the united forces of Ariobarzanes and Altinius the Roman legate; thus making himſelf once more maſter of this kingdom. In the mean time he ſent ambaſſadors to Rome, complaining of the proceedings of Nicomedes: but his ambaſſadors met with a very indifferent reception; being enjoined to tell their maſter, that he muſt either reſtore the kingdom of Cappadocia to Ariobarzanes, and make peace with Nicomedes, or be accounted an enemy of the Roman people. With this anſwer they were commanded to depart the city that very day, and told that no more ambaſſadors could be admitted till ſuch time as their commands were obeyed.

In the mean time both parties prepared for war. The Roman legates in Aſia drew together all the forces they could muſter in Bithynia, Cappadocia, Paphlagonia, and Galatia; and, being joined by Caſſius governor of Aſia, took the field againſt Mithridates in the year 19 B. C. They divided their army into ſeveral ſmall bodies: Caſſius encamped on the confines of Bithynia and Galatia; Manius Aquilius with his body poſſeſſed himſelf of the avenues leading from Pontus into Bithynia; Quintus Oppius ſecured the entrance into Cappadocia; and the admirals Minucius Rufus and C. Popilius lay with a fleet of 300 ſail at Byzantium, to prevent the enemy from entering the Euxine ſea. Each of the generals had under his command an army of 40,000 men; beſides a body of 50,000 foot and 6000 horſe brought to their aſſiſtance by Nicomedes.

18
And Nicomedes and Marius Aquilius.

On the other hand, Mithridates having invited ſeveral of the neighbouring nations to join him, collected an army of 250,000 foot, 50,000 horſe, 130 chariots armed with ſcythes; beſides 300 ſhips and 100 galleys. Part of this force he detached againſt Nicomedes; and utterly defeated him, though much ſuperior in number, as he was taking poſſeſſion of an advantageous poſt by order of Caſſius. Another part he detached againſt Manius Aquilius, whom he alſo defeated with the loſs of 10,000 killed on the ſpot, and 3000 taken priſoners; on which the other Roman generals abandoned their poſts, the fleet alſo diſperſed, and moſt of the ſhips were either taken or ſunk by the admirals of Mithridates.

19
Over-runs Aſia-Minor.

The king of Pontus now reſolving to improve the opportunity, and drive the Romans entirely out of Aſia, over-ran all Phrygia, Myſia, Aſia Proper, Caria, Lycia, Pamphylia, Paphlagonia, and Bithynia, with all the reſt of the countries which had either belonged to or ſided with the Romans, as far as Ionia. He was received everywhere with the greateſt demonſtrations of joy; the inhabitants flocking to him in white garments, and calling him their father, deliverer, their god, and the great and ſole lord of all Aſia. What gained him the affections of the people was his kind uſage to the priſoners he had taken in the two engagements abovementioned; for he not only ſent them all home without ranſom, but furniſhed them with plenty of proviſions, and money ſufficient to defray their expences by the way. Ambaſſadors flocked to him from all parts; and among others, from Laodicea on the Lycos, to whom the king promiſed his protection, provided they delivered up to him Q. Oppius governor of Pamphylia, who had fled thither for protection. This requeſt was readily complied with; Oppius was ſent to him in chains, with lictors walking before him in deriſion of the Roman pride and oſtentation. Mithridates was overjoyed to ſee a Roman general and proconſul in his power; and his joy was ſoon after increaſed by the arrival of Manius Aquilius, whom the Leſbians, revolting from the Romans, ſent to him in fetters, together with many other Romans of diſtinction who had taken ſhelter among them. As he had been the chief author of the war, Mithridates led him about with him wherever he went, either bound on an aſs, or on foot coupled with one Baſtarnes a public malefactor, compelling him to proclaim to the crowds who came to ſee him, that he was Manius Aquilius the Roman legate. When he came to Pergamus, he cauſed him firſt to be publicly whipped, then to be put on the rack, and laſtly melted gold to be poured down his throat.

20
Puts Aquilius to death.

Mithridates being now looked upon as invincible, all the free cities of Aſia received him as their ſovereign, contributing large ſums towards the defraying the expences of the war; by which means he became poſſeſſed of ſuch treaſures as enabled him to keep ſeveral numerous armies in the field for five years without levying any taxes on his ſubjects. As many Roman citizens were diſperſed in the provinces which Mithridates had ſubdued, he conſidered theſe as ſo many ſpies who would not fail to ſend an account of his proceedings to Rome: for which reaſon he reſolved to cut them all off at once by a general maſſacre; which barbarous policy, it is ſaid, had never been heard of till his time, but has been ſince practiſed by other nations. He diſpatched private letters to all the governors and magiſtrates of the cities where the Romans reſided, enjoining them on pain of death, and the entire deſtruction of their country, to cauſe all the Italian race, women and children not excepted, to be murdered on the 30th day from the date of his letters, and to let their bodies lie unburied in the open fields. One moiety of their goods was to be forfeited to the king, and the other beſtowed as a reward on the aſſaſſins. Whatever ſlave murdered his maſter was to receive his liberty, and one half of the debt was to be remitted to the debtor that ſhould kill his creditor. Whoever concealed an Italian, under any pretence whatever, was to be puniſhed with immediate death. On the fatal day, all the gates of the cities being ſhut, and the avenues kept with ſoldiers, the king's orders were proclaimed, which cauſed an univerſal horror, not only among the unhappy victims themſelves, but among thoſe who had any feelings of humanity, at ſeeing themſelves obliged either to betray and murder their innocent gueſts, friends, and relations, or to become liable to a cruel death. However, as moſt of the Aſiatics bore a mortal hatred to the Romans, and were moreover animated by the promiſe of an ample reward, the orders were without delay put in execution. The inhabitants of Epheſus, where Mithridates then reſided, dragged ſuch as had taken ſanctuary in the temple of Diana from the very ſtatue of the goddeſs, and put them to the ſword. The Pergamenians diſcharged ſhowers of darts upon them as they embraced the ſtatues in the temple of Eſculapius. At Adramyttium in Myſia many were murdered in the water, while they were attempting, with their children on their backs, to ſwim over to the iſland of Leſbos. The Caunians, who not long before had been delivered from the yoke of the Rhodians, and reſtored to their ancient privileges, excelled all the reſt in cruelty: for, as if they had apoſtatiſed from human nature, they took pleaſure in tormenting and butchering the innocent children before their mothers' eyes; ſome of them running diſtracted, and others dying with grief at a ſight which nature could not bear. The Trallians were the only people on the continent who would not have the cruelty to imbrue their hands in the blood of the innocent Italians. However, as the king's orders were peremptory, they hired one Theophilus a Paphlagonian to diſpatch the few Romans that lived among them. He, having ſhut them all up together in the temple of Concord, firſt cut off their hands as they embraced the ſtatues of the gods, and then hacked them in pieces. Many Romans were ſaved on the floating iſlands of Lydia called *Calaminæ*, where they concealed themſelves till ſuch time as they found an opportunity of eſcaping out of Aſia. Nevertheleſs,

21
Cruelly maſſacres all the Romans in Aſia.

theleſs, according to Plutarch and Dion, 150,000 Roman citizens were maſſacred on that day; but, according to others, only 80,000.

22
Reduces the iſland of Cos.

Mithridates having now got rid of thoſe whom he was in dread of on the continent, embarked great part of his forces in order to reduce the iſlands of the Archipelago. At Cos he was gladly received, and had delivered up to him the young Alexander, ſon of Alexander king of Egypt, who being driven out of that country, was killed by Chareas a ſea-captain as he was retiring in a ſmall veſſel to Cyprus. With the young prince, they put into the king's hands vaſt ſums of money, with all the golden veſſels and jewels, to an immenſe value, which his grandmother Cleopatra had been amaſſing for many years. To the young prince Mithridates gave an education ſuitable for a king's ſon, but kept the treaſures to himſelf. Here likewiſe he found 800 talents in ready money, which, at the firſt breaking out of the war, had been depoſited by the Jews of Aſia, and were deſigned for the temple of Jeruſalem.

23
But fails in his attempt upon Rhodes.

From Cos Mithridates ſteered his courſe for Rhodes, where at that time all the Romans who had eſcaped the maſſacre abovementioned found a ſanctuary, and, amongſt others, L. Caſſius the proconſul. The Rhodians, however, being very expert in maritime affairs, Mithridates did not think proper to venture an engagement. As the enemy's fleet advanced, therefore, he retired; but ſix of the Rhodian ſhips coming up with 25 of his, a ſharp action enſued, in which the Rhodians ſunk two of the king's ſhips, and put the reſt to flight. In this encounter, though Mithridates had never ſeen a ſea-fight before, he behaved with great intrepidity; but one of the ſhips of his own ſquadron falling foul of that which carried him, he was very near being taken priſoner. From this time forth he abhorred the ſea, and took an averſion to all the Chians, becauſe the pilot of that ſhip was a Chian. However, he again appeared before the iſland; but was forced anew to leave it with diſgrace, and to give over all thoughts of reducing it.

24
His generals reduce all Greece.

Mithridates now retired into Aſia, with a deſign to ſettle the civil government of the countries which he had conquered, committing the care of the war to his generals. Archelaus, his generaliſſimo, was ſent into Greece with an army of 120,000 men; where, by treachery, he made himſelf maſter of Athens, and either put to the ſword or ſent to Mithridates all thoſe who favoured or were ſuſpected to favour the Romans. From Athens he diſpatched parties to reduce the neighbouring caſtles and the iſland of Delos, which they did accordingly; but Orobius, a Roman general, hearing that the enemy kept no guards, but paſſed their time in carouſing and debauchery, fell upon them unexpectedly, and cut off the whole party, except Apellicon the commander.

In the mean time, Metrophanes, another of the king's generals, entering Eubœa, laid waſte the whole country, exerting his rage chiefly againſt the cities of Demetrias and Magneſia, which refuſed to open their gates to him. But as he was ſailing off with a great booty, Bryttius, the prætor or governor of Macedonia, coming up with him, ſunk ſome of his ſhips, and took others, putting all the priſoners to the ſword. Mithridates, upon the news of this loſs, ſent his ſon Ariarathes with a powerful army to invade Macedonia; which he ſoon reduced, together with the kingdom of Thrace, driving the Romans everywhere before him. The generals whom he ſent into other quarters were no leſs ſucceſsful; ſo that Mithridates had, according to Aulus Gellius, 25 different nations who paid him homage. The ſame author adds, that he was ſkilled in every one of their various languages, ſo that he could converſe with the natives without an interpreter. Among theſe nations we find the Rhoxani, now the Ruſſians or Muſcovites whom Deiphontus, one of the king's generals, brought under ſubjection, after having ſlain in an engagement 50,000 of the barbarians.

25
Sylla ſent againſt him.

All this time the Romans had been too much taken up with their own domeſtic quarrels to take ſuch effectual meaſures as they otherwiſe would have done for checking the progreſs of Mithridates. But at laſt, having received certain advice that the king deſigned to invade Italy, and that he had even been ſolicited to do ſo by ſome of the revolted Italians, they ſent againſt him Lucius Sylla, who had already given ſufficient proofs of his courage, conduct, and experience in war. He had with him only five legions and a few cohorts. With this inconſiderable force he landed in Attica, and in a ſhort time made himſelf maſter of the capital; Archelaus not daring, or, according to others, through treachery, not caring, to engage him. As Sylla had but a few frigates, he ſent Lucullus to the iſland of Rhodes, with orders to the Rhodians to join him with their fleet. The undertaking was very dangerous, as the king's fleet in a manner covered the ſea. However, Lucullus, deſpiſing all danger, ventured out, and ſailed, without meeting with any perverſe accident, to Syria, Egypt, Libya, and Cyprus; from whence he returned with ſuch ſupplies of ſhips and experienced mariners, as enabled Sylla, after their conjunction with the Rhodians, to act offenſively by ſea alſo. Archelaus now diſpatched meſſengers to Taxiles, who commanded in Thrace and Macedon, deſiring him to join him with all his forces; which the other readily did, and between both muſtered an army of 120,000 men. Sylla met them near Cheronæa with only 15,000 foot and 1500 horſe; but gave them a moſt dreadful overthrow, no fewer than 110,000 of the Aſiatics being ſlaughtered, while the Romans loſt only 12 men.

26
Who totally defeats his generals in Greece.

27
Flaccus and Fimbria ſent into Aſia.

This ſucceſs having raiſed envy and jealouſy againſt Sylla in Rome, the ſenate ſent Lucius Valerius Flaccus, the conſul of that year, with two legions into Aſia, in appearance to attack Mithridates on that ſide, but with private inſtructions to fall upon Sylla himſelf, if they found him diſaffected to the ſenate. As Flaccus was a man of no experience in war, C. Fimbria, a ſenator of great repute among the ſoldiery, was appointed to attend him with the character of legate and lieutenant-general. Sylla was at that time in Bœotia; but, hearing what had happened at Rome, he marched with all expedition into Theſſaly, with a deſign to meet Flaccus, who, he expected, was to land in that province. But no ſooner had he left Bœotia, than the country was over-run by an army of Aſiatics, under the command of Dorylaus the king's chief favourite. On this advice Sylla returned into Bœotia, where he gained two ſignal victories, which put an end to the war in Greece. In the firſt of theſe Dorylaus loſt 150,000 of his men according to ſome, or 200,000 according to others; and in the next all the reſt. In this laſt engagement

28
Sylla gains two other victories in Greece.

20,000

20,000 were driven into a river, where they all periſhed; an equal number were purſued into a marſh, and entirely cut off; the reſt were killed in the heat of battle, the Romans giving no quarter to men who had treated their fellow-citizens after ſuch a barbarous manner in Aſia. Plutarch tells us, that the marſhes were dyed with blood; that the courſe of the river was ſtopped by the dead bodies; and that even in his time, that is, near 200 years after, a great number of bows, helmets, coats of mail, and ſwords were found buried in the mud. Archelaus, who had joined Dorylaus with a body of 10,000 men a few days before the battle, lay three days ſtripped among the ſlain till he found a ſmall veſſel which carried him to Eubœa, where he gathered what forces he could, but was never again able to appear in the field. Indeed Livy tells us, that Archelaus betrayed the king's cauſe; and Aurelius Victor, that the king's fleet was intercepted by Sylla through the treachery of Archelaus: adding, that there was a good underſtanding between the two commanders, as was plain from Sylla's beſtowing upon Archelaus 10,000 acres of land near the city of Chalcis in Eubœa. Strabo alſo informs us, that Archelaus was afterwards greatly eſteemed and careſſed by Sylla and the ſenate; but Sylla himſelf in his commentaries, and Dio, endeavour to clear Archelaus from all ſuſpicion of treachery.

In the mean time, Sylla having given up Bœotia to be plundered by his ſoldiers, marched into Theſſaly, where he took up his winter-quarters, cauſed his old ſhips to be refitted and ſeveral new ones built, in order to paſs over into Aſia in the beginning of the ſpring, that he might drive from thence not only Mithridates, but his rival Flaccus alſo, whom the ſenate, out of oppoſition to him, had appointed governor of that province. But before he arrived, ſome differences having ariſen between Flaccus and Fimbria, the latter was by the conſul deprived of his command. Upon this Fimbria, having gained over the ſoldiery to his ſide, made war on the conſul, took him priſoner, put him to death, and aſſumed the command of all the Roman forces in Aſia. In this ſtation he behaved with the greateſt cruelty, inſomuch that his name became more odious than even that of Mithradites itſelf. This hatred the king of Pontus endeavoured to improve to his own advantage; and therefore commanded his ſon, by name alſo *Mithridates*, to join Taxiles, Diophantes, and Menander, three of his moſt experienced commanders, to return at the head of a numerous army into Aſia; not doubting but the inhabitants, thus haraſſed by Fimbria, would ſhake off the Roman yoke when they ſaw ſuch a powerful army in the field ready to protect them. But Fimbria, diſtruſting the Aſiatics, marched out to meet the enemy, and offered them battle before they entered the province. As the king's army was greatly ſuperior to the Romans in number, the latter ſuffered greatly in the engagement, but held out till night parted them, when they withdrew to the oppoſite ſide of a river, which was at a ſmall diſtance from the field of battle. Here they deſigned to intrench themſelves: but in the mean time a violent ſtorm ariſing, Fimbria laid hold of that opportunity to repaſs the river and ſurpriſe the enemy; of whom he made ſuch havock as they lay in their tents, that only the commanders and ſome few troops of horſe eſcaped. Among theſe was the king's ſon; who, attended by a few horſe, got ſafe to Pergamus, where his father reſided. But Fimbria, purſuing him night and day without intermiſſion, entered Pergamus ſword in hand; and hearing that both Mithridates and his ſon had fled from thence a few hours before, he continued his purſuit, and would have taken the king himſelf, had he not entered Pitane with a conſiderable body of horſe. The place was cloſely inveſted by Fimbria; but as he had no ſhips to block it up by ſea alſo, he ſent a meſſenger to Lucullus, who commanded the Roman navy in Aſia, intreating him, as he tendered the welfare of the republic, to make what haſte he could to Pitane, and aſſiſt him in taking the moſt inveterate enemy the Romans had. But Lucullus, preferring the gratification of a private pique to the good of his country, refuſed to come: and thus allowed the fleet of Mithridates to carry him in ſafety to Mitylene.

29 Fimbria puts Flaccus to death,

30 Defeats the forces of Mithridates,

31 And beſieges the king;

32 Who is ſuffered by Lucullus to eſcape.

Soon after the king's departure, Fimbria took Pitane by ſtorm, and reduced moſt of the cities of Aſia, particularly Troy, which he alſo took by ſtorm in eleven days, and put moſt of the inhabitants to the ſword, becauſe they had ſent an embaſſy to Sylla, offering to ſubmit to him rather than to Fimbria.—To add to the misfortunes of Mithridates, his fleet was entirely defeated in two engagements by Lucullus; ſo that he began to be weary of the war, and therefore deſired Archelaus to conclude a peace upon as honourable terms as he could. The king himſelf had afterwards alſo a conference with Sylla, and a peace was concluded in 85 B. C. on the following terms, viz. That Mithridates ſhould relinquiſh all his conqueſts, and content himſelf with his paternal dominions, which were confined within the limits of Pontus: that he ſhould immediately reſign Bithynia to Nicomedes, and Cappadocia to Ariobarzanes, and releaſe without ranſom all the priſoners he had taken during the war: that he ſhould pay to the Romans 2000, or as others will have it 3000, talents, and deliver up to Sylla 80 ſhips with all their arms and ammunition, and 500 archers; and laſtly, that he ſhould not moleſt ſuch cities or perſons as had during the war revolted from him and ſided with the Romans.

33 Peace concluded.

Sylla, having thus concluded the war with great glory to himſelf and advantage to the republic, turned his army againſt Fimbria; but the latter, finding himſelf in no condition to oppoſe his rival by force, had recourſe to treachery, and attempted to get Sylla murdered. The plot miſcarried, and Fimbria put an end to his own life; upon which Sylla, having now an uncontrouled power in Aſia, declared the Chians, Rhodians, Lycians, Magneſians, and Trojans, free, and friends of the people of Rome, by way of reward for their having ſided with the Romans: but on the other cities he laid heavy fines; condemning them in one year to pay 20,000 talents, and quartering his ſoldiers in the houſes of thoſe who had ſhown diſaffection to the Romans. Each private man was to receive of his landlord 16 drachmas a-day, and each officer 50; and beſides, both were to be ſupplied with proviſions, not only for themſelves, but for ſuch of their friends as they thought proper to invite. By theſe impoſitions moſt of the people of Aſia were reduced to beggary; eſpecially the inhabitants of Epheſus, who had above all others ſhown their hatred to the Romans. Sylla then, having collected immenſe treaſure, ſet ſail for Italy; leaving behind him Lucullus with the character of *quæſtor*, and Muræna with that of *prætor*.

The two legions which Fimbria had commanded were given to Muræna, becauſe Sylla ſuſpected them of an inclination to the faction of Marius, whoſe party he was going to cruſh at Rome.

34
Mithridates reduces the nations which had revolted from him.

Mithridates in the mean time no ſooner returned into Pontus, than he ſet about the reduction of thoſe nations which had revolted from him during the war. He began with the Colchi; who immediately ſubmitted, upon condition that Mithridates would give his ſon for a king over them. This was complied with; but the old king had thenceforward a jealouſy of his ſon, and therefore firſt impriſoned and then put him to death. Soon after this, the king having made great preparations under pretence of reducing the Boſphori, a warlike nation who had revolted from him, the Romans began to be jealous. Their jealouſy was further increaſed by Archelaus, who fled to them, and aſſured them that the preparations of Mithridates were not at all deſigned againſt the Boſphori. On hearing this, Muræna invaded Pontus without any farther provocation. The king put him in mind of the articles of peace concluded with Sylla: but Muræna replied that he knew of no ſuch articles; for Sylla had ſet nothing down in writing, but contented himſelf with the execution of what had been agreed upon. Having given this anſwer, the Roman general began to lay waſte and plunder the country, without ſparing even the treaſures or temples conſecrated to the gods. Having put all to fire and ſword on the frontiers of Pontus towards Cappadocia, he paſſed the river Halys, and on that ſide poſſeſſed himſelf of 400 villages without oppoſition; for Mithridates was unwilling to commit any hoſtilities before the return of an ambaſſador whom he had ſent to Rome to complain of the conduct of Muræna. At laſt the ambaſſador returned, and with him one Callidius; who, in public aſſembly, commanded Muræna to forbear moleſting a friend and ally of the Roman people; but afterwards, calling him aſide, he had a private conference with him, in which it is ſuppoſed, as he brought no decree of the ſenate, that he encouraged him to purſue the war. Whatever might be in this, it is certain that Muræna ſtill continued to practiſe the ſame hoſtilities, and even made an attempt on Sinope, where the king reſided and the royal treaſures were kept. But as the town was well fortified, he was forced to retire with ſome loſs. In the mean time Mithridates himſelf taking the field, appeared at the head of a powerful army, drove the Romans out of their camp, and forced them with great ſlaughter to ſave themſelves over the mountains into Phrygia; which ſudden victory again induced many cities to join Mithridates, and gave him an opportunity once more of driving the Romans out of Cappadocia.

35
The Romans invade his territories without provocation,

36
But are defeated.

In the mean time, Sylla, being created dictator at Rome, ſent a meſſenger to Muræna, charging him in his name not to moleſt Mithridates, whom he had honoured with the title of a friend and ally of Rome. Muræna did not think proper to diſregard this meſſage; and therefore immediately abandoned all the places he had ſeized, and Mithridates again renounced Cappadocia, giving his own ſon as an hoſtage of his fidelity. Being then at leiſure to purſue his other plans, Mithridates fell upon the Boſphori; and, having ſoon ſubdued them, appointed Machares one of his ſons king of the country. But leading his army from thence againſt the Achæans, a people bordering on the Colchi, and originally deſcended from the Greeks, who returning from Troy had miſtaken their way into Greece and ſettled there, he was defeated with the loſs of three-fourths of his men. On his return to Pontus, however, he recruited his army, and made vaſt preparations to invade them anew; but in the mean time, hearing of Sylla's death, he came to the imprudent reſolution of entering into a ſecond war with the Romans. Having therefore induced his ſon-in-law Tigranes, king of Armenia, to invade Cappadocia, he himſelf entered Paphlagonia at the head of 120,000 foot diſciplined after the Roman manner, 16,000 horſe, and 100 chariots armed with ſcythes. This country readily ſubmitted; after which the king marched into Bithynia, which alſo ſubmitted without oppoſition; the province of Aſia followed the example of the reſt; for theſe countries being oppreſſed with exorbitant taxes, looked upon him as their deliverer. In entering the cities of Aſia, he cauſed M. Marius or Varius, whom Sertorius had ſent him out of Spain to diſcipline his troops, walk before him with the enſigns of conſular dignity as if he was the chief magiſtrate; the king following as one of his attendants. He made ſeveral cities free; but at the ſame time acquainted the inhabitants, that they were indebted to Sertorius for their liberty; and thus, by the connivance of that general, many cities revolted from the Romans without knowing that they had done ſo. But in the mean time Julius Cæſar, being at that time at Rhodes, whither he had gone to ſtudy oratory, and hearing what havock the king's officers made in the adjacent countries, he collected what troops he could, and falling unexpectedly upon them, drove them quite out of the province of Aſia.

37
Engages in a new war with the Romans.

38
Lucullus and Cotta ſent againſt him.

The Roman ſenate, now finding a war unavoidable, appointed Lucullus to manage it. The other conſul Cotta, having ſolicited an employment in this war, was ſent with a fleet to guard the Propontis and defend Bithynia. Lucullus having raiſed one legion in Italy, paſſed over with it into Aſia, where he was joined by four others, two of which, as they had ſerved under Fimbria, proved at firſt very mutinous and refractory; nor were the other two much better, having been immerſed in the Aſiatic luxuries. The diſciplining of theſe troops took up a conſiderable time, which was prejudicial to the Roman affairs; for almoſt all the Aſiatics were ready to revolt, and Mithridates was making the greateſt preparations. One of his armies was ordered to march into Cappadocia, under the command of Diophantus Matharus, in order to oppoſe Lucullus if he ſhould attempt to enter Pontus on that ſide; another, commanded by Mithridates in perſon, conſiſted of 150,000 foot, 12,000 horſe, and 100 chariots armed with ſcythes; a third army, commanded by Marius and Eumachus, two generals of great experience in war, was encamped in the neighbourhood of Heraclea in Pontus.

39
Mithridates is at firſt ſucceſsful,

The beginning of the war proved favourable to Mithridates. Cotta being deſired by Lucullus to keep his fleet within the harbour, as being inferior to that of Mithridates, reſolved to take the firſt opportunity of fighting the king by land, not doubting of an eaſy victory. Having for this purpoſe collected all the forces he could, Cotta diſpatched his legate, P. Rutilius, with a con-a conſiderable body to obſerve the motions of the enemy. This commander being met by Marius and Eumachus, an engagement enſued, in which the Romans were defeated, and the greateſt part of them, together with their commander, cut in pieces. The ſame miſfortune befel ſeveral other officers of diſtinction ſent out to oppoſe Mithridates; who, being elated with ſucceſs, ordered his admiral to ſail into the very harbour, and fire the Roman fleet. This was accordingly performed without the leaſt oppoſition from Cotta; and 60 ſhips were taken, ſunk, or burnt, on that occaſion.

40 But is reduced to great ſtraits by Lucullus.

41 Who cuts off great numbers of his men.

Theſe victories having increaſed the rebellious diſpoſition of the Aſiatics, made Lucullus haſten his march in order to ſtop the progreſs of the enemy. But finding the king's army much more numerous than he expected, he thought proper to decline an engagement. However, ſeveral ſkirmiſhes happened, in which the Romans had always ſo much the advantage, that they became impatient for a general engagement. But Lucullus did not at this time chooſe to run ſo great a riſk; and therefore Mithridates, ſeeing he could not force the Romans to a battle, decamped in the night-time, and by day-break reached Cyzicum, a moſt important city, and greatly attached to the Romans. Lucullus purſued him; and, falling on his rear, killed 10,000, and took 13,000 priſoners. After this, the Roman general, by a manœuvre, gained an important paſs, which enabled him to cut off all communication between the army of Mithridates and the neighbouring country. The king, ſeeing himſelf thus in danger of famine, redoubled his efforts to gain the city; but finding that he could not batter down the walls, he reſolved to undermine them. In this alſo he was unſucceſsful; the beſieged ſunk countermines, and had very near taken the king himſelf in one of his own mines. In the mean time, winter coming on, the army of Mithridates was ſo diſtreſſed for want of proviſions, that many died of hunger, while the ſurvivors were forced to feed on the fleſh of their dead companions. The famine was followed by a plague; which deſtroyed ſuch numbers, that Mithridates was obliged to think of are treat; and even this was become very dangerous. However, he laid hold of the opportunity when Lucullus went away to beſiege a neighbouring caſtle, and ſent off the greateſt part of his cavalry in the night; ordering them not to halt till they were out of the reach of the enemy. But Lucullus having got intelligence of their march, ſuddenly returned, and purſued them ſo cloſe, that he came up with them as they were paſſing a river, took 600 horſe, all their beaſts of burden, 15,000 men, and put the reſt to the ſword. On his return he fell in with Ariſtonicus the king's admiral, whom he took, juſt as he was ready to ſail with a large ſum of money deſigned to bribe the Roman army. In the mean time Mithridates, finding himſelf reduced to the laſt extremity, embarked in the night-time with the greateſt part of the forces, while Marius and Eumachus, with 30,000 men, made the beſt of their way to Lampſacus. But being cloſely purſued by the Romans, they were overtaken at the river Œſopus, which at that time was not fordable, by reaſon of its having been ſwelled by heavy rains. Twenty thouſand were killed on the ſpot; nor could a ſingle man have eſcaped, had not the Aſiatics ſcattered great quantities of gold and ſilver in the way, that the march of the Romans might be retarded by their ſtopping to gather it up. Lucullus on his return entered Cyzicum amidſt the acclamations of the citizens; who afterwards inſtituted public ſports in honour of him, which they called *Lucullea.* The city was declared free and all the privileges, exemptions, and immunities, beſtowed upon the citizens which were enjoyed by the inhabitants of Rome itſelf.

42 Lucullus gains a great victory at ſea.

From Cyzicum, Lucullus marched along the coaſt of the Helleſpont till he came to Troas; where he equipped his fleet, and put to ſea in queſt of Marius, Alexander, and Dionyſius, three of the king's generals, who had a fleet of 50 ſhips, with 10,000 land forces on board. Lucullus came up with them near the iſland of Lemnos, took 32 of their ſhips, and put a great number of their land-forces to the ſword. The day after the engagement the three generals were diſcovered in a cave where they had concealed themſelves, and dragged from thence to Lucullus; who after having ſeverely upbraided Marius for fighting againſt his country, cauſed him to be put to death. Alexander and Dionyſius were reſerved for the triumph; but the latter poiſoned himſelf to avoid that diſgrace. Lucullus then ſteered his courſe for Bithynia, on receiving intelligence that Mithridates had appeared with his fleet on thoſe coaſts: but the king having notice of his approach, made what haſte he could to gain Pontus, and arrived at Heraclea on board a pirate named *Selemus;* with whom he was obliged to truſt himſelf, his fleet being diſperſed by a violent ſtorm, and the ſhip that carried him caſt away.

43 Farther ſucceſſes of Lucullus.

In the mean time Mithridates was no leſs unfortunate by land than by ſea. Triarius, one of the officers of Lucullus, reduced the cities of Apamea, Pruſa, Pruſias, and Nicæa. From thence he marched with all expedition to Nicomedia, where the king himſelf was, and near which place Cotta lay encamped. But before the two armies could be joined, Mithridates eſcaped, firſt to Heraclea, which was betrayed to him, and from thence to Sinope. Nor was Lucullus himſelf all this time inactive. Having reduced all Paphlagonia and Bithynia, he marched through Cappadocia, and joined Cotta and Triarius at Nicomedia, with a deſign to invade Pontus; but hearing that Heraclea was in the hands of Mithridates, he diſpatched Cotta to reduce that city. Triarius was ordered with the fleet to the Helleſpont and Propontis, to intercept the king's fleet, which was daily expected from Spain with ſupplies from Sertorius. Lucullus himſelf, with the main ſtrength of the army, purſued his march into Pontus. His army was greatly haraſſed, eſpecially in the narrow paſſes between Cappadocia and Pontus, by flying parties of the enemy. But the greateſt inconvenience was the want of proviſions, as the king's troops had laid waſte all the country round; inſomuch that Lucullus having loſt almoſt all his beaſts of burden, was obliged to take along with the army 30,000 Galatians, each of them carrying a ſack of corn on his back. At laſt, however, he gained the plains of Pontus; where proviſions were ſo plentiful, that an ox was ſold for a drachma, and every thing elſe in proportion.

The Roman general having now carried the war into the enemy's country, divided his forces, and at the ſame time inveſted a very ſtrong town named *Amiſus;* another called *Eupatoria,* built by Mithridates, and made the place of his reſidence; and another, named *Themiſcyra*, ſituated on the banks of the Thermodoon. Eupatoria was ſoon taken, but Themiſcyra made a vigorous reſiſtance. The townſmen galled the Romans to ſuch a degree, that, not daring to approach the walls openly, they contented themſelves with undermining them: but in this too they met with no ſmall difficulty; for the enemy countermined, and often engaged them, under ground, letting into the mines bears and other wild beaſts, with ſwarms of bees, which obliged them to abandon their works. However, the town was at laſt obliged to ſurrender for want of proviſions. As for Amiſus, Lucullus himſelf ſat down before it: but finding it ſtrongly fortified and garriſoned with the flower of the king's troops, the Roman general thought proper to reduce it by famine; and on this occaſion his countrymen firſt complained of him as protracting the war for his own advantage.

44
The army of Mithridates mutinies, which obliges the king to fly into Armenia.

In the mean time Mithridates having recruited his ſhattered army, advanced to Cabiræ, a city not far diſtant from Amiſus. Lucullus, leaving part of the army to continue the ſiege, marched at the head of the reſt to oppoſe Mithridates. But the king having drawn his cavalry into a general engagement, defeated them with conſiderable loſs, and drove them back to the mountains, through the paſſes of which Lucullus had lately marched to attack him. This check obliged the Roman general to retire to a riſing ground near the city of Cabiræ, where the enemy could not force him to an engagement. Here proviſions beginning to grow ſcarce, Lucullus ſent out ſtrong parties from his army into Cappadocia, the only place from whence he could have ſupplies. One of theſe parties entirely defeated Taxiles and Diophantes, two of the king's generals, who had been ſtationed there to prevent Lucullus from having any communication with the country. The king, upon the news of this defeat, reſolved to break up his camp and retire, not queſtioning but that Lucullus would attack him as ſoon as his forces returned. This reſolution he no ſooner imparted to his nobles, than they began privately to ſend away their moſt valuable goods; which being found out by the ſoldiers, they took it in ſuch bad part that no intelligence had been given them, that they plundered their baggage, and put thoſe who had the care of it to the ſword. After this they betook themſelves to flight, crowding out of the gates in the utmoſt confuſion. The king haſtened to ſtop their flight; but nobody ſhowing him the leaſt reſpect, he was carried away by the crowd, and in great danger of being trampled to death. Having with difficulty made his eſcape, he retired with a ſmall retinue, firſt to Cabiræ, and then to his ſon-in-law Tigranes king of Armenia. Lucullus diſpatched the beſt part of his cavalry to purſue the fugitives; while he himſelf with the reſt, inveſted the camp of Mithridates, where thoſe remained who could not fly with the reſt. The camp was eaſily taken; but moſt of the ſoldiers made their eſcape, while the Romans, contrary to their general's orders, were buſied in plundering. Lucullus then purſued hard after the king; who, being overtaken by a company of Galatians, cauſed a mule loaded with part of his treaſures to be driven in among them, by which means he made his eſcape while they quarrelled about the booty. Mithridates, remembering in his flight, that he had left his ſiſters, wives, and concubines at Pharnacia, diſpatched an eunuch, named *Bacchus* or *Bacchides*, with orders to put them all to death, leſt they ſhould fall into the hands of the enemy; which was accordingly done.

After the flight of Mithridates, the Romans no longer met with any oppoſition; the king's governors flocking from all parts to put themſelves under the protection of the conqueror. Among theſe was the grandfather of Strabo the geographer, whom the king had diſobliged by putting to death his couſin-german Tibias, and his ſon Theophilus. He was a man of ſuch credit, that it was no ſooner heard that he had abandoned the king's party, than 15 other commanders delivered up to Lucullus the places with which they had been intruſted; and about the ſame time Triarius falling in with the king's fleet near the iſland of Tenedos, obtained a complete victory, having either taken or ſunk 60 of the enemy's veſſels.

All this time Cotta had been employed without ſucceſs in beſieging Heraclea, which he could never have reduced without the aſſiſtance of Triarius. That commander, having defeated the fleet, ſoon reduced the town to ſuch diſtreſs, that a third part of the garriſon died of hunger; upon which the governor, Conacorix, privately agreed with Triarius to deliver one of the gates to him. This was accordingly done; and the Romans, entering, made a terrible ſlaughter of the helpleſs inhabitants. But in the mean time Cotta, provoked at ſeeing himſelf deprived both of all ſhare of the booty, and the honour of reducing a place before which he had ſat ſo long, fell upon his countrymen as they were buſied in plundering; which would have occaſioned a great deal of bloodſhed, had not Triarius promiſed to divide the booty equally. Conacorix, in order to conceal his treachery, after marching out of Heraclea, ſeized on two forts belonging to the Romans; and Triarius being ſent to recover them, Cotta, in his abſence, plundered the city anew, rifled the temples which the other had ſpared, put all the citizens he could meet with to the ſword, and having carried off every thing valuable, at laſt ſet fire to the city in ſeveral places, by which means it was ſoon reduced to aſhes. Cotta then, having no farther occaſion for his troops, diſmiſſed the auxiliaries, reſigned his legions to Lucullus, and put to ſea himſelf in order to return to Rome. But he had ſcarce got out of the harbour, when part of his ſhips, being overloaded with the ſpoils of the city, ſunk; and the others were by a violent north wind daſhed againſt the ſhore, which occaſioned the loſs of a great part of the booty. However, on his return to Rome, he was highly applauded by the ſenate, and honoured with the title of *Ponticus*.

Lucullus, having now reduced Pontus, marched againſt the Chaldeans, Tibarenians, and inhabitants of Armenia Minor; who voluntarily ſubmitted to him, and put him in poſſeſſion of all their ſtrong holds. From Armenia, he returned before Amiſus, which ſtill held out; Callimachus, governor of the place, having haraſſed the Romans to ſuch a degree by engines of his own contriving, that they had given over their aſſaults, and contented themſelves with blocking it up by land, though the garriſon was at the ſame time plentifully ſupplied with proviſions by ſea. Lucullus, on his arrival, ſummoned the city to ſurrender, offering the inhabitants very honourable terms; but, being refuſed, he made a general aſſault at the time when he knew that Callimachus uſed to draw off great part of his troops to give them ſome reſpite. The Romans applying their ſcaling ladders, got over the wall before Callimachus could come to the aſſiſtance of thoſe whom he had left to guard it; however, by ſetting the city on fire, he found means in that confuſion to make his eſcape. Lucullus commanded his men to uſe their utmoſt endeavours to ſave the city; but they being intent only upon plundering, regarded nothing but the furniture. At laſt the fire was extinguiſhed by a violent ſhower; and Lucullus, having with much ado reſtrained his ſoldiers from committing any farther exceſſes, repaired the city in ſome meaſure before he left it, and ſuffered the inhabitants to enjoy their poſſeſſions in peace.

45 Tigranes defeated by Lucullus,

Nothing was now wanting but the captivity of Mithridates himſelf to put a final period to the war; and therefore Lucullus demanded him from his ſon-in-law Tigranes. But though that prince could not be prevailed to ſee Mithridates on account of his miſconduct, he could as little be induced to deliver him up to his enemies. After this refuſal, however, he for the firſt time condeſcended to ſee his father-in-law, after he had reſided a year and eight months in his dominions. In a private conference held by the two kings, it was agreed, that Tigranes ſhould march againſt the Romans, and Mithridates with 10,000 horſe return into Pontus, where he ſhould make what levies he could, and rejoin Tigranes, before Lucullus, who was then employed in the ſiege of Sinope, could enter Armenia. But, in the mean time, Sinope having ſurrendered, Lucullus with all poſſible expedition marched againſt Tigranes, and, having drawn him into a general engagement, gave him an entire defeat, as is related under the article ARMENIA.

46 But reſolves to try another campaign,

47 Mithridates defeated.

Mithridates was marching to his aſſiſtance, when he met his ſon-in-law flying with a ſmall retinue to ſhelter himſelf in ſome remote corner of the kingdom. He encouraged him to raiſe new forces; not doubting but that another campaign would repair all former loſſes, provided he would commit to his management every thing relating to the war. To this Tigranes agreeing, as he thought him more fit to deal with the Romans than himſelf, orders were iſſued out for raiſing a new army, and all the Armenians able to bear arms ſummoned to meet at the place of the general rendezvous. Out of theſe Mithridates choſe 70,000 foot and 35,000 horſe; and having trained them up during the winter, after the Roman diſcipline, in the beginning of the ſpring he left part of them with Tigranes, and marched himſelf with the reſt into Pontus, where he recovered many important places, and overcame in a pitched battle M. Fabius, whom Lucullus had appointed governor of that province. Being fluſhed with this ſucceſs, as ſoon as the wounds he received in the engagement ſuffered him to move, he purſued Fabius, and beſieged him in the city of Cabira, whither he had retired; but in the mean time Triarius, who was marching out of Aſia to join Lucullus, hearing what diſtreſs the Romans were in, haſtened to their relief, and appearing unexpectedly on the neighbouring hill, ſtruck ſuch terror into the enemy, that they raiſed the ſiege, and made the beſt of their way into Cappadocia. Triarius purſued them, and got ſo near them as to be parted only by a river. Here he halted with a deſign to paſs the river after he had allowed his men ſome reſt; for they were tired out with long marches. But Mithridates was before-hand with him, and croſſing the river on a bridge, where he had placed a ſtrong guard, attacked the Romans with great reſolution before they had time to refreſh themſelves. The battle was bloody, and the event doubtful, till the bridge breaking down with the weight of the multitude that paſſed, the king's troops who had engaged, relying chiefly on their numbers, began to loſe courage, ſeeing they could receive no farther aſſiſtance; and the Romans charging them with freſh vigour, they betook themſelves to a precipitate flight. After this engagement, as winter came on, both armies were glad to retire to their winter-quarters.

48 Defeats Triarius.

During the winter, Mithridates raiſed new forces; and having received conſiderable ſupplies from Tigranes, took the field early in the ſpring, in hopes of driving the Romans quite out of Pontus, before Lucullus, who had work enough on his hands in Armenia, could come to their aſſiſtance. With this view he marched ſtraight againſt Triarius and Sornatius, to whom Lucullus had committed the care and defence of that province; and finding them encamped near the city of Gaziurſa, proffered them battle; which they declining, he ſent a ſtrong detachment to beſiege a caſtle where the Romans had left all their baggage, hoping they would rather venture an engagement to relieve the place, than loſe all they had got with ſo much toil and labour during the war: neither was he diſappointed in his hopes; for though Triarius was for keeping cloſe in his camp till the arrival of Lucullus, whom he daily expected, having acquainted him with the danger, the ſoldiers hearing that the caſtle was beſieged, declared in a tumultuous manner, that if he did not lead them they would march to the relief of the place without his leave. Triarius being thus forced by his own men to fight, drew out his forces againſt the king, whoſe army was three times his number; but while they were upon the point of engaging, both armies were by a violent ſtorm forced to retire to their reſpective camps; but Triarius receiving that very day intelligence of the approach of Lucullus, and fearing he would ſnatch the victory out of his hands, reſolved to make a bold puſh, and next morning by break of day attack the king in his camp. If he conquered, the glory he thought would be entirely his own; if he were overcome, the enemy could reap no great advantage from his victory, Lucullus being at hand with a powerful army. The king, in that ſurpriſe, putting himſelf at the head of a few troops of his guards, ſuſtained the brunt of the Romans, till the reſt of his army drawing up came to his relief, and attacked the enemy with ſuch fury, that the Roman foot were forced to give way, and were driven into a moraſs, where they were ſurrounded, and great numbers of them cut in pieces.

Their horſe were likewiſe put to flight, and purſued with great ſlaughter, till a Roman centurion in the king's ſervice, pitying his countrymen, attempted to kill him. The king's life was ſaved by his breaſtplate; but as he received a deep wound in the thigh, he was obliged to give over the purſuit himſelf, and thoſe that were about him cauſed the retreat to be ſounded, which, as it was unexpected, occaſioned a great confuſion in the whole army. The centurion was immediately cut in pieces; but the Roman horſe in the mean time getting the ſtart of the enemy, found means to make their eſcape. Above 7000 of the Romans were killed in that battle; and among them 150 centurions and 24 tribunes, the greateſt number of officers that had been loſt in any engagement to that day. Mithridates being cured of his wound, that he might not for the future be expoſed to ſuch dangers, cauſed all the Romans that ſerved in his army to be formed into one body, as if they were to be ſent out on a party, and then ordered them to retire to their tents, where they were all to a man cut in pieces.

49 All the Romans in the ſervice of Mithridates maſſacred.

The king, however elated with ſucceſs, yet would not engage Lucullus; but with long marches haſtened into Armenia Minor, and encamped upon a hill near the town of Talura, expecting Tigranes, who was advancing with a ſtrong army to join him. Lucullus, in purſuit of Mithridates, marched over the field of battle, leaving thoſe unburied who had fallen in the engagement, which alienated the minds of the ſoldiery from him, and they began to be very mutinous; being ſtirred up by Appius Claudius, whom Lucullus had turned out of his command for his vile behaviour, notwithſtanding he was nearly related to him, Lucullus having married his ſiſter. The diſcontent that prevailed in the army came to ſuch a height, that Lucullus was obliged to lie ſtill in his camp all that ſummer; the ſoldiers declaring in a mutinous manner, that they would not follow him any longer, nor ſerve under a general who refuſed to ſhare the booty with them.

50 Lucullus recalled, which retrieves the affairs of Mithridates.

Theſe complaints, and the general diſcontent that reigned in the army, obliged the ſenate to recal Lucullus, and appoint Manius Acilius Glabrio, conſul of that year, in his room. Glabrio arriving in Bithynia, gave notice by public cries to all the cities, that the ſenate had diſcharged Lucullus and his army, and confiſcated his goods for protracting the war and refuſing to comply with their injunctions. Hereupon Lucullus was abandoned by the greater part of his army, and forced to retire into Galatia, not being in a condition to make head againſt the joint forces of the two kings; who, laying hold of that opportunity, recovered the beſt part of Pontus, Bithynia, Cappadicia, and Armenia Minor: for though Glabrio had haſtened into Pontus, as if he had intended to engage the enemy and rob Lucullus of the victory, yet, upon the firſt news of the approach of the two kings, he thought fit to retire and leave the country open on all ſides to the enemy.

51 Pompey ſent againſt him.

When this was heard at Rome, a law was enacted there by C. Manilius, a tribune of the people, whereby the management of the war againſt Mithridates and Tigranes was committed to Pompey, and likewiſe the provinces of Cilicia, then under Quintus Marcius, and of Bithynia under Glabrio. By the ſame law he was continued in that unlimited power by ſea, with which he was inveſted when he firſt ſet out againſt the pirates of Cilicia. In virtue of this law, Pompey, who had juſt then ended the war with the Cilician pirates, took upon him the command of the army, and directed all the allies of the Roman people to join him with all poſſible expedition: but before he took the field, he renewed the alliance which Sylla and Lucullus had concluded with Phrahates king of Parthia, and then ſent friendly propoſals to Mithridates; who at firſt ſeemed inclined to give ear to them, and accordingly diſpatched an ambaſſador to the Roman army to treat of a peace. Pompey required of him to lay down his arms if he was in earneſt, and deliver up to him all thoſe who had revolted from the Romans during the war. This demand was no ſooner reported abroad in the king's camp, but the deſerters, who were very numerous in the king's army, betaking themſelves to their arms, threatened to put Mithridates himſelf to death; and would have occaſioned a great diſturbance, had not the king appeaſed the growing tumult, by aſſuring them, that he had ſent ambaſſadors, not to treat of a peace, but only to take, under pretence of ſuing for peace, a view of the enemy's ſtrength. He moreover obliged himſelf, by a ſolemn oath in the preſence of the whole army, never to enter into any treaty of friendſhip with the Romans, nor to deliver up to them ſuch as had ever ſerved under him.

52 Mithridates rejects his propoſals of peace.

Pompey, finding his propoſals rejected, advanced againſt the king with an army of 30,000 foot and 20,000 horſe, as Plutarch writes, or 30,000, as we read in Appian, all choſen troops; for he diſcharged moſt of thoſe who had ſerved under Glabrio and Lucullus. As he entered Galatia, he was met by Lucullus, who endeavoured to perſuade him to march back, the war being near finiſhed, and even deputies ſent by the republic to ſettle the province of Pontus; but not being able to prevail with him, after mutual complaints againſt each other, they parted; and Pompey removing his camp, commanded the troops that were with Lucullus to join him, except 1600 whom he left to attend Lucullus in his triumph. From thence Lucullus ſet out for Rome, where he was received by the ſenate with great marks of eſteem, moſt men thinking him highly injured by the authors of the Manilian law. Pompey purſued his march into Pontus; but finding that he could not by any means draw the king to a battle, he marched back into Armenia Minor, with a deſign either to reduce that province, or oblige Mithridates to venture a battle in order to relieve it. Mithridates followed him at ſome diſtance; and entering Armenia, encamped on a hill over-againſt the Romans, and, by intercepting their convoys, reduced them to ſuch diſtreſs, that they were obliged to remove to a more convenient place, the king cutting off many in their rear, and haraſſing them with frequent attacks, till he fell into an ambuſcade laid by Pompey, whoſe perſonal courage and prudent conduct on that occaſion confirmed the king in his reſolution not to hazard a general engagement. The two armies encamped over-againſt each other; Pompey on one hill, and the king on another, near the city of Daſtira, in the province of Aciſilene, at a ſmall diſtance from the Euphrates, which divides Aciſilene from Armenia Minor.

53 Is beſieged by Pompey.

Here Pompey, ſeeing he could neither draw the king to a battle, nor force his camp, which was pitched on a ſteep and craggy mountain, began to block him up with a ditch which he carried round the bottom of the hill where the king was encamped; and meeting with no oppoſition, finiſhed his work, and quite cut off the enemy's communication with the country. Pompey was amazed to ſee the king thus tamely ſuffer himſelf to be ſhut up; and could not help ſaying, That he was either a great fool or a great coward: a fool, if he did not apprehend the danger he was in; a coward, if, being appriſed of it, he did not to the utmoſt of his power prevent it. By this ditch, which was 150 furlongs in circuit, and defended by many forts raiſed at ſmall diſtances from each other, the king was ſo cloſely beſieged, that he could neither ſend out parties to forage, nor receive the ſupplies that came to him from Pontus. He was thus beſieged for the ſpace of 45 or 50 days; and his army reduced to ſuch ſtraits, that, having conſumed all their proviſions, they were at laſt forced to live on their dead horſes. Hereupon Mithridates reſolved at all events to break through the Roman fortifications: and accordingly, having put to the ſword all thoſe that were ſick or diſabled, that they might not fall into the enemy's hands, he attacked in the dead of the night the Roman guards; and having overpowered them with his numbers, got ſafe into the open fields, and continued his march all night towards Armenia Major, where he was expected by Tigranes.

54
But breaks through the Roman lines.

Pompey next morning by break of day purſued the enemy with his whole army; and having with much ado overtaken them, found the king encamped on a hill, to which there was but one aſcent, and that guarded by a ſtrong body of foot. The Romans encamped over-againſt them; but Pompey, fearing the king ſhould make his eſcape in the night-time, privately decamped, and taking the ſame rout the enemy were to hold in order to gain Armenia, poſſeſſed pimſelf of all the eminences and defiles through which the king was to paſs. Mithridates thinking that Pompey was returned to his former camp, purſued his march, and about the duſk of the evening entered a narrow valley, which was ſurrounded on all ſides by ſteep hills. On theſe hills the Romans lay concealed, expecting the ſignal to fall upon the enemy and attack them on all ſides at once, while they were tired with their march, and ſeemingly, as they had ſent out no ſcouts, in great ſecurity. Pompey was at firſt for putting off the attack till the next morning, thinking it not ſafe to engage in the night-time among ſuch ſteep and craggy mountains; but was at laſt prevailed upon, by the earneſt prayers and intreaties of all the chief officers of the army, to fall upon the enemy that very night. It was therefore agreed, that in the dead of the night all the trumpets ſhould at once ſound the charge, that this ſignal ſhould be followed by an univerſal ſhout of the whole army, and that the ſoldiers ſhould make what noiſe they could, by ſtriking their ſpears againſt the braſs veſſels that were uſed in the camp. The king's army at this ſudden and unexpected noiſe, which was echoed again by the mountains, imagined at firſt that the gods themſelves were come down from heaven to deſtroy them; and the Romans charging them on all ſides with ſhowers of ſtones and arrows from the tops of the hills, they betook themſelves to a precipitate flight; but finding all the paſſes beſet with ſtrong bodies of horſe and foot, were forced to fly back into the valley, where, for many hours together, they were expoſed to the enemy's ſhot, without being able, in that confuſion, either to attack them or defend themſelves. They attempted indeed to make ſome reſiſtance when the moon roſe; but the Romans running down upon them from the hills, did not give them time to draw up, and the place was ſo narrow that they had not room even to make uſe of their ſwords. The king loſt on that occaſion 10,000 men according to Appian, but 40,000, according to Eutropius and others. On Pompey's ſide there fell between 20 and 30 private men, and two centurions.

55
Is over-reached by Pompey, and totally defeated.

56
Diſtreſs of Mithridates.

Mithridates, at the head of 800 horſe, broke through the Roman army, and being after this effort abandoned by all the reſt, becauſe they were cloſely purſued by the enemy, he travelled all night attended by three perſons only, *viz.* his wife, or, as Plutarch calls her, his *concubine*, by name *Hypſicratia*, his daughter Dripetine, and an officer. At day-break he fell in with a body of mercenary horſe, and 3000 foot, who were marching to join him. By theſe he was eſcorted to the caſtle of Sinoria, ſituated on the borders of the two Armenias. As great part of his treaſures were lodged here, he rewarded very liberally thoſe who accompanied him in his flight; and taking 6000 talents, withdrew into Armenia. As ſoon as he entered the borders, he diſpatched ambaſſadors to Tigranes, acquainting him with his arrival; but that prince, who was then on the point of concluding a ſeparate peace with the Romans, clapped his ambaſſadors in irons, pretending that his ſon Tigranes, had at the inſtigation of Mithridates, revolted firſt to the Parthians, and then to the Romans. Mithridates finding himſelf thus abandoned, even by his ſon-in-law, left Armenia; and directing his courſe towards Colchis, which was ſubject to him, and not as yet invaded by the Romans, paſſed the Euphrates the fourth day, and got ſafe into his own territories.

Pompey ſent out ſeveral parties in purſuit of the king; but remained himſelf with the main body of the army in the field of battle, where he built a city, calling it from that remarkable victory *Nicopolis*. This city, with the adjoining territory, he beſtowed upon ſuch of his ſoldiers as were old or diſabled; and many flocking to it from the neighbouring countries, it became in a ſhort time a very conſiderable place. This battle was certainly attended with very fatal conſequences for Mithridates; who was forced, his army being entirely either cut off or diſperſed, to abandon his own dominions, and fly for ſhelter to the moſt remote parts of Scythia. Pompey having concluded a peace with Tigranes, as we have related in the hiſtory of Armenia, and ſettled the affairs of that kingdom, began his march in purſuit of Mithridates through thoſe countries that lie about mount Caucaſus. The barbarous nations through which he paſſed, chiefly the Albanians and Iberians, attempted to ſtop his march, but were ſoon put to flight. However, he was obliged, by the exceſſive cold and deep roads, to paſs the winter near the river Cyrus. Early in the ſpring he purſued his march; but meeting with great oppoſition from the Iberians, a warlike nation, and entirely devoted to Mithridates, he was employed moſt part of the ſummer in reducing them. In the mean time, Mithridates, who had wintered at Dioſcurias, on the iſthmus between the Euxine and Caſpian ſeas, and had been joined there by ſuch of his troops as had made their eſcape from the late unfortunate battle, continued his flight through the countries of the Achæans, Zygians, Heniochians, Cercetans, Moſchi, and Colchians. Of theſe nations ſome received him kindly, and even entered into alliance with him; through others he was forced to make himſelf a way with his ſword.

57
He flies into Scythia, and from thence into other countries.

Pompey took the ſame rout, directing his courſe

58 Pompey's further conqueſts.

by the ſtars, eſpecially in the northern parts of Scythia, and carrying with him even proviſion of water, to ſupply the army in the vaſt deſerts through which he marched. He ſpent two years in warring with theſe nations, and was often in danger of loſing both his life and his army: but at laſt he overcame them all; and believing Mithridates, of whom he could have no account, to be dead, he marched back into Armenia Minor, where he allowed ſome reſt to his ſoldiers, who were quite worn out with the hardſhips they had endured in that expedition. Having refreſhed his army, he marched into Pontus, to reduce ſome ſtrong holds which were ſtill garriſoned by the king's troops. While he was at Aſpis in Pontus, many of the king's concubines were brought to him; but he ſent them all home to their parents, without offering them the leaſt injury, and thereby gained the affection of the chief lords of Pontus, whoſe daughters they were. The ſtrong caſtle of Symphori was delivered up to him by Stratonix, one of the king's concubines, upon no other terms than that he would ſpare her ſon Xiphares, who was with the king, in caſe he ſhould fall into his hands. She likewiſe diſcovered to him great treaſures hid under ground, which he, with great generoſity, beſtowed upon her, reſerving for himſelf only ſome veſſels to ſet off his triumph. Having taken another fort, called the *New Caſtle*, and to that time looked upon as impregnable, he found in it great ſtore of gold, ſilver, and other valuable things, which he afterwards conſecrated to Jupiter Capitolinus. Here, in looking over the king's manuſcripts, he came to diſcover where the reſt of his treaſures were concealed, what troops he could raiſe and maintain, what ſums were yearly paid him by his ſubjects and tributaries, &c. whereby he could make a true eſtimate of his whole power and wealth. Amongſt other manuſcripts he found ſome books of phyſic, wrote by Mithridates himſelf, which he commanded Lenæas, a learned grammarian, to tranſlate into Latin.

59 Mithridates appears again at the head of a conſiderable army.

Pompey, having thus reduced all Pontus, marched into Syria, with a deſign to recover that kingdom, and paſſing through Arabia to penetrate as far as the Red Sea. But while he was employed in this expedition, news was brought him that Mithridates, whom he believed dead, had appeared unexpectedly in Pontus at the head of a conſiderable army, and ſurpriſed Panticapæum, a famous empory at the mouth of the Euxine Sea. He had lain all this time concealed in the territories of a Scythian prince adjoining to the Palus Mœotis; but hearing that Pompey had left Pontus, and was engaged in other wars, he ventured out of his hiding-place, reſolved either to recover his paternal kingdom, or die in the attempt. He returned privately into Pontus and managed matters there ſo dexterouſly, that the Roman garriſons knew nothing of his arrival till he appeared with a conſiderable army in the field. He advanced firſt to the caſtle of Symphori; and underſtanding that Stratonix had delivered it up to Pompey, on condition he would ſave the life of her ſon in caſe he ſhould take him priſoner, the king immediately cauſed the youth, who was in his army, to be put to death, and his body to be left unburied, Stratonix beholding from the walls the cruel and unnatural murder, for he was her ſon by Mithridates, and had ſerved him with great fidelity. At the ſame time he ſent ambaſſadors to Pompey to treat of a peace, offering to pay a yearly tribute to the republic, on condition he reſtored to him his kingdom. Pompey replied, that he would hearken to no propoſals whatſoever, without the king came to treat with him in perſon, as Tigranes had done. This Mithridates looked upon as nowiſe conſiſtent with his dignity; and therefore laying aſide all thoughts of an accommodation, began to make what preparations he could for renewing the war.

60 Recovers ſeveral places.

He ſummoned all his ſubjects that were able to bear arms to meet at an appointed place; and having choſen out of the whole multitude 60 cohorts, each conſiſting of 100 men, he incorporated them with the regular troops that were already on foot. Being now in a condition to act offenſively, for Pompey had left but a ſmall number of troops in Pontus, he poſſeſſed himſelf of Phanagorium, Cherſoneſus, Theodoſia, Nymphæum, and ſeveral other important places. But in the mean time, Caſtor, whom Mithridates had appointed governor of Phanagorium, falling out with Tripho, one of the king's favourite eunuchs, killed him, and dreading the king's reſentment, ſtirred up the inhabitants to a revolt: by which means Phanagorium was again loſt; but the caſtle, which was defended by four of the king's ſons, Artaphernes, Darius, Xerxes, and Oxathres, held out for ſome time. The king haſtened to their relief; but the caſtle being ſet on fire by the rebels, they were forced to ſurrender themſelves to Caſtor before his arrival. Theſe four ſons, with one of the king's daughters, by name *Cleopatra*, Caſtor ſent to the Romans; and fortifying himſelf in the town, perſuaded moſt of the neighbouring cities, which were oppreſſed with heavy taxes, and ſtrangely haraſſed by the king's collectors, to join in the rebellion.

61 His ſubjects diſcontented.

62 His extraordinary deſign of invading Italy.

Mithridates finding that he could neither rely upon the ſoldiery, moſt of them being forced into the ſervice, nor on his other ſubjects, who were diſſatisfied by reaſon of the exorbitant taxes, ſent ambaſſadors to invite the princes of Scythia to his relief, and with them his daughters, to be beſtowed in marriage upon ſuch as ſhowed themſelves moſt inclined to aſſiſt him. But as the ambaſſadors he employed on this occaſion were eunuchs, a race of men no leſs abhorred by the army than favoured by the king, over whom they had a great aſcendant, eſpecially in his old age, the ſoldiers who were ſent to attend them on their journey, put them all to the ſword as ſoon as they were out of the king's reach, and delivered his daughters up to the Romans. Mithridates, finding himſelf thus deprived of his children, betrayed by his army, and forſaken even by thoſe on whom he chiefly relied, could not yet be induced to ſubmit to the Romans, though Pompey promiſed him honourable conditions, provided he came to treat with him in perſon. In this deſperate condition, he left no ſtone unturned to ſtir up the princes of Aſia againſt the Romans, eſpecially the Parthians; but finding them awed by the great opinion they all had of Pompey, he had recourſe at laſt to the European Gauls whom he underſtood to be at war with the Romans; and having ſent before ſome of his truſty friends to engage them in his favour, taking leave of his own kingdom, he began his long march, deſigning to paſs through Boſphorous, Cimmerius, Scythia,

thia, Panonia, &c. and joining the Gauls, paſs the Alps, and invade Italy.

This deſign was no ſooner known in the army, but the ſoldiers openly began to complain and mutiny; exaggerating the boldneſs of the attempt, the length of the march, and the unſurmountable difficulties that muſt neceſſarily attend ſuch a deſperate enterpriſe. The chief commanders did all that lay in their power to divert him from it; repreſenting to him, that if he was not able to cope with the Romans in his own kingdom, much leſs would he be a match for them in Italy or Gaul, where they could daily receive new ſupplies; whereas he would loſe the greateſt part of his army in ſo long and difficult a march, and the reſt perhaps in the firſt engagement, without any poſſibility of repairing the loſs. But all was to no purpoſe; for they found him ſo unalterably fixed in his reſolution, that he cauſed thoſe to be put to death who with moſt warmth remonſtrated againſt it, not ſparing even his own ſon Exipodras, for dropping ſome unguarded expreſſions on that occaſion. Thus they were forced to let him purſue his own meaſures, till they found a more proper opportunity to oppoſe them, which ſoon after offered, as they were encamped at Boſphorus Cimmerius, on their march into Scythia.

63
His ſon Pharnaces revolts.

Here Pharnaces, the king's favourite ſon, whom he had appointed to ſucceed him, obſerving the general diſcontent that reigned in the army, began to entertain thoughts of placing the crown on his own head; and not doubting but the ſoldiery would ſtand by him, if he declared againſt the intended expedition into Italy, openly proteſted among the Roman deſerters, who were a conſiderable part of the army, that if they would follow him he would return into Pontus. The Romans who were well appriſed of the danger that attended ſuch an undertaking, and had moſt of all exclaimed againſt it, promiſed to ſupport him to the utmoſt of their power, and even encouraged him, upon ſome expreſſions which he purpoſely dropped, to aſſume the title of *king*, a title which his father ſeemed determined to hold till he had deſtroyed, by his raſh and deſperate attempts, himſelf, his friends, and his army. Pharnaces, finding he could depend on the Romans, engaged the ſame night moſt of the chief commanders in his party, and by their means the greater part of the ſoldiery. It was agreed, that next morning by break of day all thoſe who had declared in his favour ſhould appear in arms, and with a loud ſhout proclaim Pharnaces king; which was done accordingly, and the ſhout returned even by thoſe whom Pharnaces had not thought fit to let into the ſecret. The king, who had taken up his quarters in the city, being awakened by the noiſe, ſent out ſome of his domeſtics to know what had happened in the army. Neither did the officers or ſoldiers diſſemble the matter, but boldly anſwered, that they had choſen a young king inſtead of an old dotard governed by eunuchs.

Hereupon Mithridates mounting on horſeback, and attended by his guards, went out to appeaſe the tumult: but his guards forſaking him, and his horſe being killed under him, he was obliged to fly back into the city; from whence he ſent ſeveral of his attendants one after another to deſire of his ſon a ſafe conduct for himſelf and his friends. But as none of the meſſengers returned, ſome being ſlain, and others ſiding with the new king, Mithridates endeavoured to move his ſon to compaſſion, by ſignifying to him from the walls the diſtreſſed condition he was reduced to by a ſon whom he had favoured above the reſt of his children; but finding him nowiſe affected by his ſpeech, turning to the gods, he beſeeched them with many tears to make his ſon know one day by experience the grief and agony which a father muſt feel in ſeeing his love and tenderneſs requited with ſuch ungrateful and monſtrous returns. Having thus ſpoke, he thanked in a very obliging manner thoſe who had ſtood by him to the laſt, and exhorted them to make their ſubmiſſion to the new king on the beſt terms they could procure; adding, that as for himſelf, he was determined not to outlive the rebellion of a ſon whom he had always diſtinguiſhed with particular marks of paternal affection.

64
Mithridates attempts to deſtroy himſelf.

After this, he withdrew into the apartment of his wives and concubines, where he firſt took poiſon himſelf, and then preſented it to them, and to his favourite daughters Mithridatis and Niſſa, who not long before had been betrothed to the kings of Egypt and Cyprus. To the women it proved immediate death; but on the king, who from his infancy had inured his conſtitution to poiſonous potions, it had ſo ſlow an operation, that he was forced, through fear of falling into the rebels' hands, to recur to his ſword. Neither did the wound, as he was greatly weakened by the poiſon, prove mortal: ſo that the rebels, having in the mean time ſtormed the town, and broke into the houſe, found the king wallowing in his blood, but ſtill alive, and in his ſenſes; which Pharnaces hearing, ſent ſome of thoſe that were about him to dreſs his wounds, with a deſign to deliver him up to the Romans, and thereby ingratiate himſelf with Pompey.—But, in the mean time, a Gaul, who ſerved in the army, by name *Bitætus*, or *Bithocus*, entering the king's room in queſt of booty, and being touched with compaſſion in ſeeing him forſaken by all his friends, and ſtruggling on the bare ground with the pangs of death, drawing his ſword, put an end to his preſent agonies, and prevented the inſults which he chiefly apprehended if he ſhould fall alive into his ſon's hands. The barbarian is ſaid, when he firſt ſaw the king, to have been ſo awed with the majeſty of his countenance, that, forgetful of his booty, he fled out of the room; but being called back, and earneſtly intreated by the dying prince to put an end to his miſery, he ſummoned all his courage to perform, as he did, with a trembling hand, that office; and immediately retired without touching any thing that belonged to the king, though the hopes of a rich booty was the only motive that had led him thither.

65
A Gaul puts an end to his life out of compaſſion.

66
Exceſſive joy of the Romans at his death.

Pompey, who was at that time engaged in a war with the Jews, received the firſt notice of the death of Mithridates as he was on his march to Jeruſalem. The meſſenger who brought the joyful tidings was ſent by Pharnaces, and appeared unexpectedly before Pompey with the branch of a laurel, as was cuſtomary on the like occaſions, twiſted round the head of his javelin. When he heard what had happened at Panticapæum, he was ſo impatient to impart it to the ſoldiery, that he could not even wait till they had raiſed him a mount of turf from whence to ſpeak to the army, according to the cuſtom of the camp; but ordered thoſe who were by him to form a kind of mount with their ſaddles, and from thence acquainted the ſoldiery that Mithridates had laid violent hands on himſelf, and his ſon Pharnaces was ready to acknowledge the kingdom as a gift of the people of Rome, or reſign it if they were unwilling he ſhould reign. This news was received with joyful ſhouts of the whole army, and the day ſolemnized with feaſts and ſacrifices throughout the camp, as if in Mithridates alone all the enemies of the republic had died. Pompey diſpatched without delay a meſſenger with letters to the ſenate, acquainting them with the death of Mithridates, and the ſubmiſſion of his ſon Pharnaces. When his letters were read, the ſenators were ſo overjoyed, that they appointed at the propoſal of Cicero, then conſul, 12 days for returning due thanks to the gods, who had delivered them from ſuch an inſulting and powerful enemy; and the tribunes of the people enacted a law, whereby Pompey, in conſideration of his eminent ſervice in the Mithridatic war, was to wear a crown of laurel, with the triumphal gown at the Circenſian ſports, and a purple gown at the ſcenical plays.

67
Submiſſive embaſſy of Pharnaces to Pompey;

Pharnaces, when he heard of his father's death, cauſed his body to be preſerved in brine, propoſing to preſent it to Pompey, who had promiſed to return into Pontus after the reduction of Judæa, and there ſettle matters to his ſatisfaction. And accordingly having taken the city and temple of Jeruſalem, he ſet out with two legions for Pontus; and being arrived at Sinope, he was there met by ambaſſadors from Pharnaces, acquainting him, that their maſter had forbore aſſuming the title of king till his will and pleaſure were known; that he put both himſelf and the kingdom entirely into his hands; and that he was willing to attend him at what time or place he thought fit to appoint. The ſame ambaſſadors delivered up to Pompey thoſe who had taken Manius Aquilius the Roman legate, whom Mithridates had put to a cruel death, all the priſoners, hoſtages, and deſerters, whether Romans, Greeks, or Barbarians, and the body of Mithridates with his rich apparel and arms, which were greatly admired by Pompey and the other Romans. Both ſoldiers and officers flocked to ſee the king's body; but Pompey declined that ſight; and, ſaying that all enmity between that great prince and the people of Rome was ended with his life, he returned the body to the ambaſſadors, and cauſed it to be interred with the utmoſt pomp and magnificence among his anceſtors in the burying-place of the kings of Pontus, Pompey defraying all the charges of that ceremony, which was the moſt coſtly and pompous that ever had been ſeen in thoſe parts. With the body Pompey reſtored his wearing apparel and armour; but the ſcabbard of his ſword, which coſt 400 talents, was ſtolen by Rublius a Roman, and ſold to Ariarathes king of Cappadocia; and his cap or turban, which was a very curious piece of workmanſhip, was privately taken by one Caius, who preſented it to Fauſtus the ſon of Sylla, in whoſe houſe it was kept, and ſhown for many years after among the many rarities which Sylla had brought out of Aſia.

Pompey beſtowed the kingdom of Boſphorus on Pharnaces, and honoured him with the title of a friend and ally of the people of Rome. Pharnaces being thus acknowledged king of Boſphorus, ſent orders to all the garriſons of Pontus to ſubmit themſelves with the caſtles and treaſures with which they were entruſted, to Pompey, who by that means amaſſed an immenſe booty. In the city of Talaura, which Mithridates uſed to call his wardrobe, he found 2000 cups of onyx ſet in gold, with ſuch ſtore of gold and ſilver veſſels, of coſtly furniture, of ſaddles, bridles, and trappings, ſet with jewels and precious ſtones, that the Roman commiſſaries ſpent 30 days in taking the inventory of the whole. In another caſtle he found three large tables with nine ſalvers of maſſy gold, enriched with precious ſtones to an ineſtimable value; the ſtatues of Minerva, Mars, and Apollo, of pure gold and moſt curious workmanſhip; and a pair of gaming-tables of two precious ſtones, three feet broad, and four feet long, on which was a moon of gold weighing 30 pounds, with their men, all of the ſame precious ſtone. In a fort ſituated among the mountains, were delivered up to him the king's ſtatue of maſſy gold, eight cubits high, his throne and ſceptre, and the bed of Darius the ſon of Hyſtaſpes. Moſt of theſe treaſures had been tranſmitted to him from his anceſtors, chiefly from Darius king of Perſia; ſome belonging to the Ptolemies of Egypt, and had been depoſited by Cleopatra, as we have hinted above, in the hands of the Coans, who delivered them to Mithridates; and great part of them had been collected by the king himſelf, who was very fond of rich and ſtately furniture.

68
Who beſtows upon him the kingdom of Boſphorus.

Pompey having thus got entire poſſeſſion of Pontus, and reduced it to the form of a Roman province, marched into *Aſia* properly ſo called; and having wintered at Epheſus, early in the ſpring ſet out for Italy, with a fleet of 700 ſhips. As he brought over his army with him, the ſenate was under no ſmall apprehenſion leſt he ſhould make himſelf abſolute, and rule without controul. But he no ſooner landed at Brunduſium, than he diſbanded the army, without waiting for any decree either of the ſenate or people; what neither his friends nor his enemies had believed. His triumph laſted two whole days; and though he was attended in his triumphal chariot by 324 captives of diſtinction, among whom were five ſons and two daughters of Mithridates, yet he would not ſuffer any of them to be put to death, as had been done by others; but ſent them all back, except ſuch as were of royal extraction, to their reſpective countries, and even ſupplied them with money to defray the charges of their journey. After his triumph he delivered into the treaſury 20,000 talents, though, at the diſmiſſing of the army, he had divided 16,000 talents among the tribunes and centurions, 2000 ſeſtertiums among the quæſtors, and had given to each ſoldier 50 ſeſtertiums.

69
Pharnaces falls out with the Romans.

Pompey had no ſooner left Aſia, but Pharnaces fell unexpectedly upon the Phanagorenſes, a people of Boſphorus, whom Pompey had declared free, becauſe they had revolted the firſt of all from Mithridates, and by their example induced others to abandon the king's party. Pharnaces beſieged their chief city Phanagoria, and kept them blocked up till, for want of proviſions, they were forced to ſally out, and put all to the iſſue of a battle; which proving unſucceſsful, they delivered up themſelves and their city to the conqueror. Some years after, the civil war breaking out between Cæſar and Pompey, he laid hold of that opportunity to recover the provinces which his father had formerly poſſeſſed; and having raiſed a conſiderable army, overran Pontus, Colchis, Bithynia, Armenia, and the kingdom of Moſchis, where he plundered, as Strabo obſerves, the temple of the goddeſs Leucothea. He took the ſtrong and important city of Sinope, but could not reduce Amiſus. But, in the mean time, Cæſar having got the better of Pompey and his party, appointed Cn. Domitius Calvinus governor of Aſia, enjoining him to make war upon Pharnaces with the legions that were quartered in that province. Domitius immediately diſpatched ambaſſadors to Pharnaces, commanding him to withdraw his troops from Armenia and Cappadocia. The king returned anſwer, that he was willing to abandon Cappadocia, but as for the kingdom of Armenia Minor, it was part of his hereditary dominions; and therefore he would not reſign it till he had an opportunity of laying his pretenſions before Cæſar himſelf, whom he was ready to obey in all things. Hereupon Domitius drawing together what forces he could, marched into Cappadocia, which he recovered without oppoſition, Pharnaces having abandoned it to make a ſtand in Armenia, which lay nearer his own dominions. Thither Domitius purſued him; and having overtaken him near Nicopolis, found his army drawn up in battle-array, and the king ready to come to an engagement; which Domitius not declining, both armies advanced.

70 And defeats them.

The king, at the head of a choice body of men, fell upon the Romans' left wing, conſiſting moſtly of raw and undiſciplined Aſiatics; and having without much ado put them to flight, penetrated to the centre, where the thirty-fifth legion, the only one which Domitius had, after a faint reſiſtance, gave ground, and, retiring to the neighbouring mountains, left their allies to ſhift for themſelves, who were all cut off. Domitius with the remains of his ſcattered army marched back into Cappadocia; and from thence, winter drawing on, into the province of Aſia. The king being puffed up with this victory, and hearing that Cæſar, with the flower of the Roman forces, was engaged at the ſiege of Alexandria, appointed one Aſander governor of Boſphorus, and marched himſelf into Cappadocia in purſuit of Domitius, with a deſign to invade Aſia, and recover all the provinces which had been once ſubdued by his father. Bithynia and Cappadocia readily ſubmitted; but Armenia the Leſſer, which was held by Dejotarus, made ſo vigorous a reſiſtance, that he was forced to give over the enterpriſe, leſt the Romans ſhould in the mean time ſtrengthen themſelves in Aſia, whither he was in haſte to march, in hopes of meeting there with the ſame ſucceſs as his father Mithridates had done. But before he reached that province, he was informed that Aſander had revolted, in hopes of gaining thereby the good-will of the Romans, and obtaining of them the kingdom of Boſphorus for himſelf. At the ſame time, he received intelligence that Cæſar, having at laſt reduced Alexandria, and ſettled the affairs of Egypt and Syria, was marching into Armenia.

71 Attempts to outwit Julius Cæſar,

He was not a little diſmayed at this news, and therefore without delay diſpatched ambaſſadors to ſue for peace; hoping that Cæſar, who was haſtening into Italy with a deſign to paſs over into Africa, would willingly give ear to any propoſals of that nature.—Cæſar courteouſly entertained the ambaſſadors; and though he did not propoſe to agree to their conditions, yet, that he might come upon Pharnaces unawares, he ſhowed himſelf very deſirous of entering into a treaty of peace. But, in the mean time, he purſued his march with all poſſible expedition; and arriving on the confines of Pontus, ordered all the troops that were quartered in the neighbouring provinces to join him; for he had brought from Alexandria but one legion, namely the ſixth, and that conſiſting of 1000 men only, the reſt having been killed at the ſiege of Alexandria. Beſides this veteran legion, he found at the place of general rendezvous three others, but all of them very indifferently armed, and worſe diſciplined. With theſe forces, however, ſuch as they were, he advanced againſt Pharnaces; who being greatly frightened at his approach, by reaſon of the ſucceſs that had attended him in all his expeditions, again diſpatched ambaſſadors to him with a crown of gold, offering him his daughter in marriage, and promiſing to do whatever he ſhould require. The ambaſſadors took care to let him know that their maſter, though highly obliged to Pompey, yet had never been prevailed upon to ſend him any ſupplies during the civil war, which Dejotarus, king of Armenia the Leſſer, whom he had honoured with his friendſhip, had done. Cæſar returned for anſwer, that he was willing to conclude a peace with Pharnaces, provided [illegible]e retired without delay from Pontus, returned all the captives and hoſtages whether Roman or their allies, and reſtored the goods of the Roman citizens and publicans which he had ſeized ſince he firſt took up arms. He added, that as to his not ſending ſupplies to Pompey, they ought rather to have concealed ſuch an ungrateful proceeding of their maſter than alleged it as any merit, ſince the forſaking of one to whom he was indebted for his crown, beſpoke him a man of mean, ſelfiſh, and unworthy principles.

Pharnaces, upon the return of his ambaſſadors, acquainted Cæſar that he agreed to the conditions; but finding that Cæſar's affairs called him into Italy, he required a longer term of time for the performance of what was ſtipulated between them, ſtarting daily new difficulties, in hopes that Cæſar would in the mean time be obliged to depart, and leave his affairs of Pontus in the ſame poſture he had found them. Cæſar ſeeing himſelf diſappointed, and put off from day to day, could not longer brooke the king's deceitful behaviour. Wherefore he determined to put himſelf at the head of his ſmall army, and attack the enemy in his camp when he leaſt expected it. And accordingly, marching out in the night, he came by break of day in ſight of the king's army; and uttering theſe words, *Shall this treacherous parricide go unpuniſhed?* broke into the camp at the head of 1000 horſe. The king's chariots, which were armed with ſcythes, cauſed ſome ſmall diſorder among Cæſar's horſe; but in the mean time the reſt of his army coming up, he put the enemy to flight, and obtained a complete victory.

72 By whom he is entirely defeated.

This battle was fought near the place where Mithridates had routed with great ſlaughter the Roman army under the command of Triarius. Moſt of the king's army were either taken or cut in pieces; but Pharnaces himſelf had the good luck to make his eſcape while the Romans were buſy in plundering the camp. This victory was ſo quick, that

Cæſar in a letter to his friend Aminitius, or Anitius, at Rome, expreſſed it in three words, thus: "I came, I ſaw, I conquered." He ever afterwards uſed to call Pompey a fortunate rather than a great commander, ſince he had gained his chief glory in the Mithridatic war, fighting with ſo cowardly an enemy. He divided the rich booty and the ſpoils of his camp among his ſoldiers; and becauſe Mithridates had erected a trophy near that place as a monument of his victory over Triarius, which Cæſar, as it was conſecrated to the gods, did not think lawful to pull down, he ſet up another over-againſt it to tranſmit to poſterity his victory over Pharnaces. After this victory he recovered and reſtored to the allies of the people of Rome all the places which Pharnaces had poſſeſſed himſelf of during the war, declared Amiſus a free city, and appointed Mithridates Pergamenus king of Boſphorus in the room of Pharnaces.

Having thus ſettled the affairs of Pontus, he ſet ſail for Italy; leaving Domitius Calvinus to purſue the war againſt Pharnaces, if he ſhould appear again in the field. Pharnaces had retired after the battle to Sinope with 1000 horſe, where he was quickly beſieged by Domitius, to whom he ſurrendered the town, upon no other condition than that he ſhould be ſuffered to retire into Boſphorus with the ſmall body that attended him. This Domitius willingly granted; but cauſed all the king's horſes to be killed, ſince he had aſked a ſafe-conduct only for his horſemen. With theſe and a band of Scythians and Sarmatians he attempted to recover the kingdom of Boſphorus; but being met between Theodocia and Panticapeum, both which cities he had reduced, by Aſander, who was ſtill in poſſeſſion of the kingdom, a ſharp engagement enſued, wherein the king's men, as not being uſed to fight on foot, were put to flight, and Pharnaces himſelf, who remained alone in the field, was ſurrounded by the enemy, and cut in pieces, after having reigned in Boſphorus Cimmerius, the kingdom which Pompey had beſtowed upon him, according to Appian, fifteen years, according to others, ſeventeen.

73
Is killed in another engagement.

Upon the death of Pharnaces the kingdom of Pontus, was again reduced to the form of a province, and ſo continued to the triumvirate of Marc Antony, who after the battle at Philippi conferred it upon Darius the ſon of Pharnaces for his ſervices during the civil war. He continued faithful to the Romans; but did nothing during his reign worth mentioning.

74
Pontus again made a kingdom by Marc Antony.

Darius was ſucceeded in the kingdom by Polemon, likewiſe preferred to that honour by Marc Antony. He was the ſon of Zeno, a famous orator of Laodicea, and greatly favoured by Antony. From him that part of Pontus which borders on Cappadocia borrowed the name of *Polemoniacus*. He attended Marc Antony in his expedition againſt the Parthians; and being taken priſoner in that unſucceſsful battle fought by Statianus, he was ſent by the king of the Medes, an ally of the Parthians, to conclude a peace with the Romans. In which embaſſy he acquitted himſelf ſo well, that Antony added the kingdom of Armenia to his own dominions. In the war between Antony and Auguſtus he ſided with the former: but after the battle of Actium he was received into favour by the latter; and being ſent by Agrippa againſt Scribonius, who upon the death of Aſander had uſurped the kingdom of Boſphorus, he overcame him, and reduced the kingdom of Colchis, which was beſtowed upon him by Agrippa, who likewiſe honoured him with the title of *friend and ally of the people of Rome*. He afterwards waged war with the neighbouring barbarians refuſing to live in ſubjection to the Romans; but was overcome, taken, and put to death, by the Aſpungitani, a people bordering, according to Strabo, on the Palus Mœotis.

Upon his death his ſon Polemon II. was by the emperor Caligula raiſed to the throne of Boſphorus and Pontus. But the emperor obliged him to exchange the kingdom of Boſphorus with part of Cilicia; and Nero, with his conſent, reduced that part of Pontus which he enjoyed to the form of a province. He fell in love with Berenice, daughter to Agrippa king of Judæa; and in order to marry her embraced the Jewiſh religion. But as ſhe ſoon became tired of his riotous way of living, and returned to her father; ſo he renounced his new religion, and again embraced the ſuperſtitions of Paganiſm. Polemon dying without iſſue, the ancient kingdom of Pontus was parcelled out into ſeveral parts, and added to the provinces of Bithynia, Galatia, and Cappadocia, only that part of it which was called *Pontus Polemoniacus* retaining the dignity of a diſtinct and ſeparate province. During the civil diſcords between Veſpaſian and Vitellius, one Anicetus, firſt a ſlave, afterwards freedman, to king Polemon, and laſtly commander of the royal navy, took up arms with a deſign to reſcue the kingdom from the Roman bondage; and being joined by great multitudes drawn together with the proſpect of ſpoil, over-ran the country, and poſſeſſed himſelf of Trapeſund, a city founded by the Grecians on the utmoſt confines of Pontus. Here he cut in pieces a cohort made up of the inhabitants, but which had been formerly preſented with the privilege of Roman citizens. He likewiſe burnt the fleet, and with ſcorn and inſults ſcoured the ſea; Mucianus having called to Byzantium moſt of the Roman galleys. Hereupon Veſpaſian, who was at that time in Syria, ſent Verdius Gemnius into Pontus with a choice body of auxiliaries from the legions. He aſſailing the enemy while they were in diſorder, and roaming aſunder in purſuit of prey, drove them into their veſſels; then with ſome galleys chaſed Anicetus into the mouth of the river Chobus, where he thought himſelf ſafe under the protection of Sedochus king of the Lazians, whoſe alliance he had purchaſed with large ſums and rich preſents. Sedochus at firſt refuſed to deliver him up to the Romans; but was ſoon prevailed upon, partly by threats, partly by preſents, to ſurrender both him and all the other fugitives who had taken ſanctuary in his dominions. Thus ended that ſervile war; and the kingdom of Pontus continued to be a province of the empire till the time of David and Alexis Comneni, who being driven from Conſtantinople by the French and Venetians A. D. 1204, under the command of Baldwin earl of Flanders, ſettled, the one at Heraclea, the other at Trebiſond. The troubles that aroſe among the Latins gave Alexis Comnenus an opportunity of erecting here a new empire, which comprehended great part of Pontus, and was known by the name of the *empire of Trebiſond*. The Comneni held it about 250 years, till the time of Mohammed II. who carried David Comnenus, the laſt emperor of Trebiſond, priſoner to Conſtantinople, A. D. 1462, with all his family, and ſubjected his empire to that of Conſtanti-

75
Is parcelled out into ſeveral provinces.

nople;

Island of Ponza. Fig. 3. Plate CCCCXII

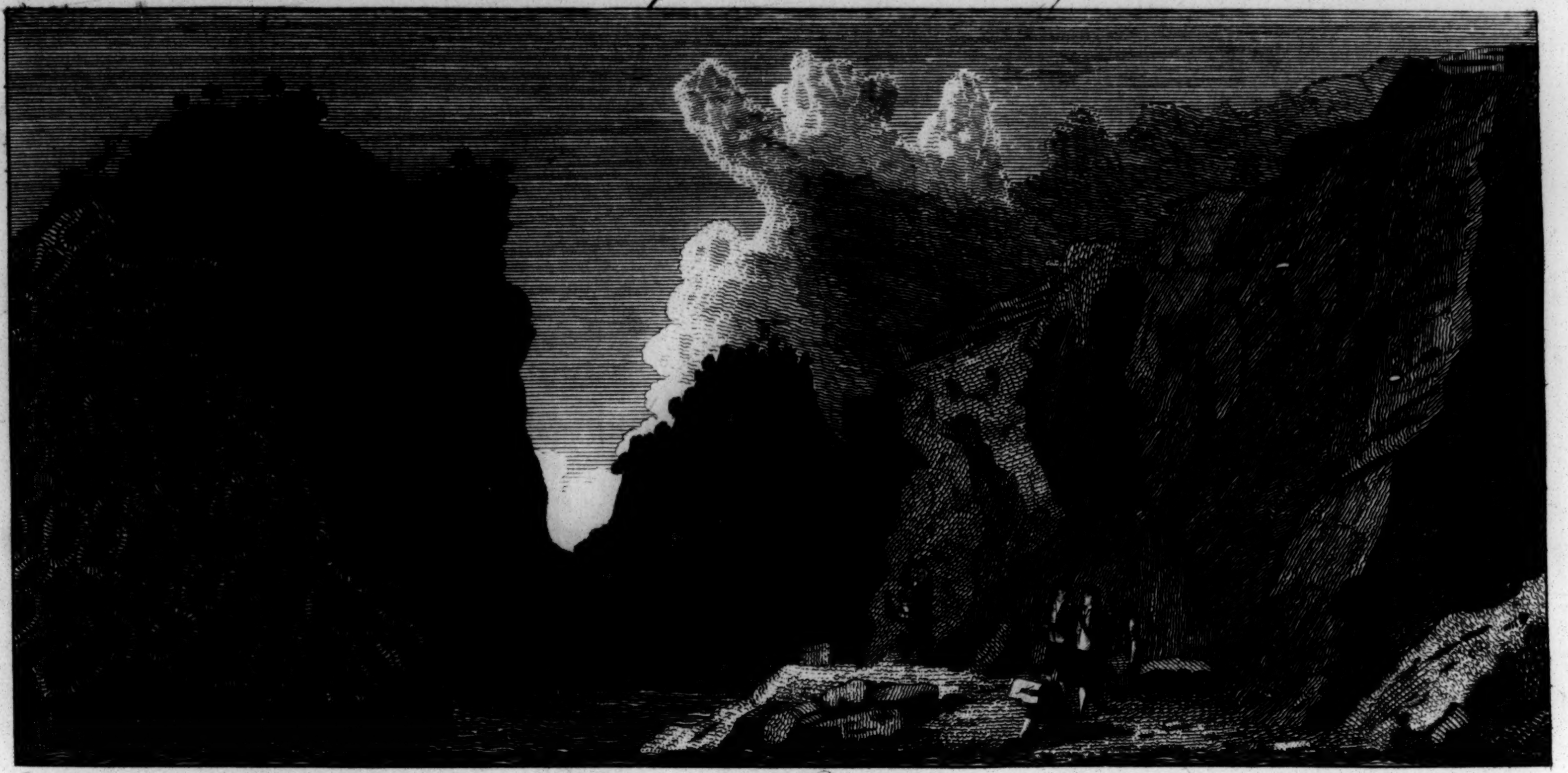


Fig. 2.

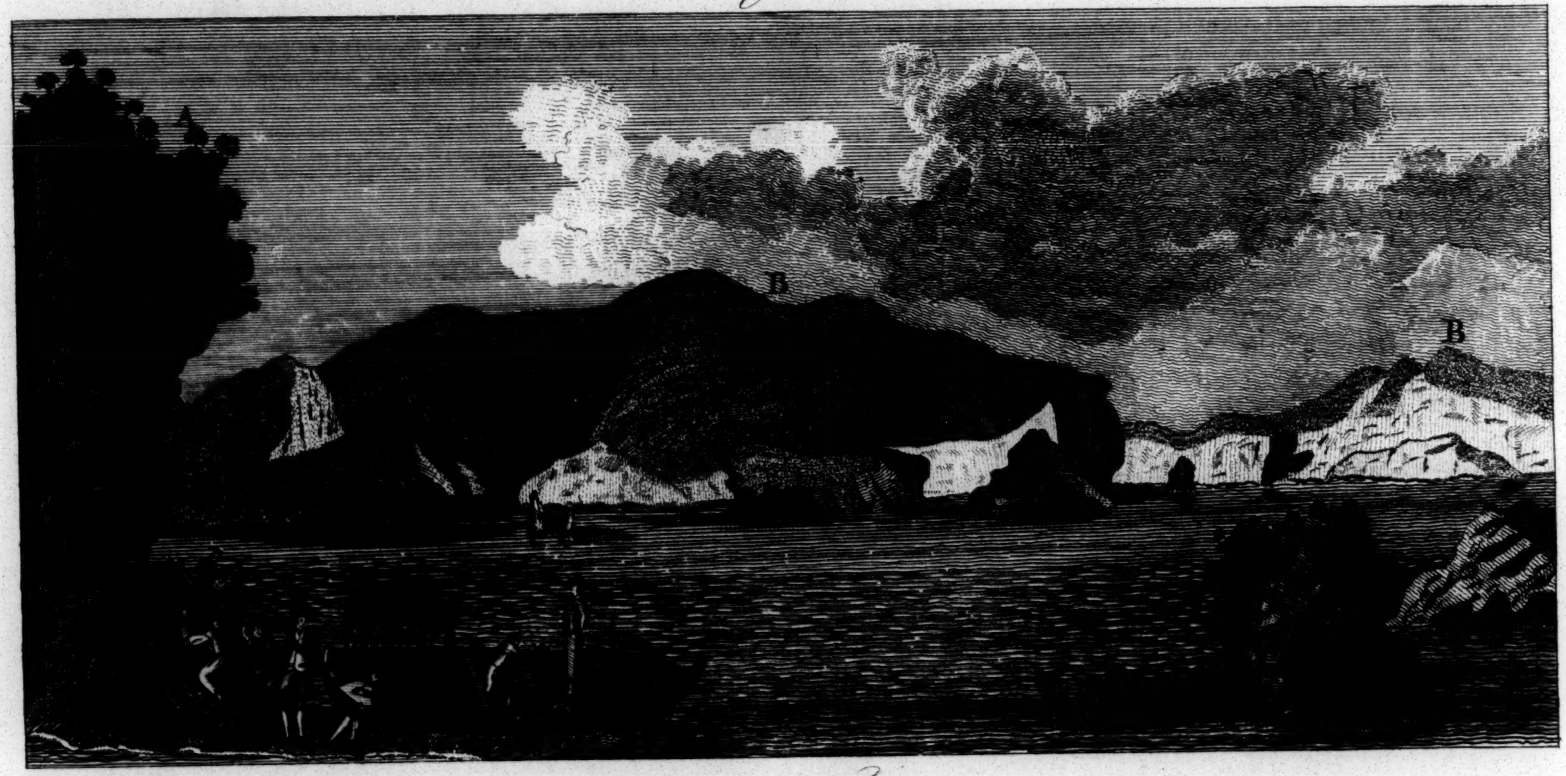
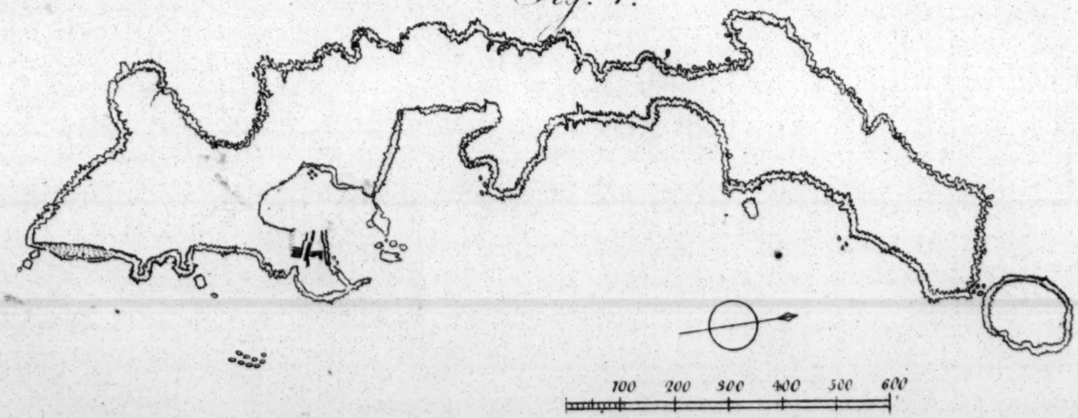


Fig. 1.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nople; in which abject ſlavery Trebiſond and all Pontus have continued ever ſince.

PONTYPOOL, a town of Monmouthſhire in England, ſeated between two hills. It is but a ſmall place, though noted for its iron-mills, great manufacture of japanned mugs, &c. W. Long. 3. 6. N. Lat. 51. 42.

PONZA, or **PONTIA**, is a ſmall iſland of the Tuſcan Sea, well known to be the place to which many illuſtrious Romans were formerly baniſhed. It is ſituated on the coaſt of Italy near Terracina, and in the neighbourhood of other ſmall iſlands or rocks named *Palmarole*, *Zannone*, &c. between the iſland of Ventotienne and Monte Circello. All theſe iſlands were viſited by Sir William Hamilton in the year 1785; and an account of his journey is given in a letter to Sir J. Banks, which appeared in the Phil. Tranſ. vol. lxxvi. p. 365. Sir William arrived at Ponza on the 20th Auguſt; and, according to his account, it lies about 30 miles from Ventotienne. On the 21ſt he went round it in a boat. Its length is about five miles, but its breadth is nowhere above half a mile, and in ſome places not more than 500 feet. It is ſurrounded by a multitude of detached rocks, ſome of them very high, and moſt of them compoſed of a compact lava. There are many irregularly formed baſaltes, but none in large columns. In ſome places they have a reddiſh tinge from iron ochre, are very ſmall, and irregularly laid over one another. Some ſtand perpendicularly, others obliquely, and ſome lie horizontally. The rocks themſelves in which theſe maſſes are found are lava of the ſame nature with the baſaltes. At firſt ſight they appear like the ruins of ancient Roman brick or tyle buildings. One rock is compoſed of large ſpherical baſaltes, and in other places our author found the lava inclined to take the like ſpherical form, though on a much ſmaller ſcale, ſome of the former baſaltes being near two feet in diameter. All theſe rocks, in our author's opinion, have been detached by the ſea from this iſland, which is entirely compoſed of volcanic matter, lavas, and tufas of various qualities and colours, as green, yellow, black, and white. Some of theſe matters are more compact in their texture than others; and in ſome parts great tracts ſeem to have undergone ſimilar operations, which ſtill ſubſiſt at a ſpot called the *Piſciarelli*, on the outſide of the Solfatara, near Puzzole, and where a hot ſulphureous vitriolic acid vapour converts all which it penetrates, whether lavas, tufas, volcanic aſhes, or pumice-ſtones, into a pure clay, moſtly white, or with a tint of red, blue, green, or yellow.

In one part of this iſland there is a ſort of tufa remarkably good for the purpoſe of building. It is as hard as Bath-ſtone, and nearly of the ſame colour, without any mixture of lava or pumice-ſtone, which uſually abound in the tufas of Naples, Baia, and Puzzoli.

The iſland of Palmarole which is about four miles from Ponza, is not much more than a mile in circumference. It is compoſed of the ſame volcanic matter, and probably was once a part of Ponza; and in our author's opinion it looks as if the iſland of Zannone, which lies about the ſame diſtance from Ponza, was once likewiſe a part of the ſame; for many rocks of lava riſe above water in a line betwixt the two laſt-mentioned iſlands, and the water there is much more ſhallow than in the gulf of Terracina.

Zannone is much larger and higher than Palmarole; and that half of it next the continent is compoſed of a lime-ſtone ſimilar to that of the Apennines near it; the other half is compoſed of lavas and tufas, reſembling in every other reſpect the ſoil of the iſlands juſt deſcribed. Neither Palmarole nor Zannone are inhabited; but the latter furniſhes abundance of bruſhwood for the uſe of the inhabitants of Ponza, whoſe number, including the garriſon, amounts to near 1700. The uninhabited iſland of St Stefano in like manner furniſhes wood for the people of Ventotienne. It is probable that all theſe iſlands and rocks may in time be levelled by the action of the ſea. Ponz, in its preſent ſtate, is the mere ſkeleton of a volcanic iſland; little more than its hard or vitrified parts remaining, and they ſeem to be ſlowly and gradually mouldering away. The governor of the caſtle of Ponza, who had reſided there 53 years, told our author that the iſland was ſtill ſubject to earthquakes; that there had been one violent ſhock there about four years before; but that the moſt violent one he ever felt was on the very day and at the hour that Liſbon was deſtroyed. Two houſes out of three which were then on the iſland were thrown down. "This (ſays our author) ſeems to prove that the volcanic matter which gave birth to theſe iſlands is not exhauſted."

Fig. 1. Plate CCCCXII. is a plan of the iſland of Ponza as it is given in the Philoſophical Tranſactions. Fig. 2. is a view of the inſide of the harbour of the iſland. A in the ſame figure is a rock of lava. In many parts it is formed into regular baſaltes of a reddiſh colour, tinged in all probability with ſome ochre. Moſt of the detached rocks of the iſland reſemble this. BB repreſents a tract of volcanic country, converted by a hot ſulphureous vitriolic acid vapour into a pure clay, the ground colour of which is moſtly white.—Fig. 3. is a view from the outſide of the harbour, near the lighthouſe. C is a rock of volcanic matter converted to pure clay; D is a rock of the ſame kind, with ſtrata of pumice-ſtone: E is a rock of lava, inclining to take baſaltic forms; and F is a rock compoſed of ſpherical baſaltes.

POOD is a Ruſſian weight, equal to 40 Ruſſian or 36 Engliſh pounds.

POOL is properly a reſervoir of water ſupplied with ſprings, and diſcharging the overplus by ſluices, defenders, weirs, and other cauſeways.

POOL, a ſea-port town of Dorſetſhire in England. It is ſurrounded on all ſides by the ſea, except on the north, where there is an entrance through a gate. It was formerly nothing but a place where a few fiſhermen lived: but in the reign of Henry VI. it was greatly enlarged, and the inhabitants had the privilege to wall it round. It was alſo made a county of itſelf, and ſent two members to parliament. It is governed by a mayor, a ſenior bailiff, four other juſtices, and an indeterminate number of burgeſſes. The town conſiſts of a church and about 600 houſes, with broad paved ſtreets; and has a manufactory of knit hoſe. It is 47 miles weſt-ſouth-weſt of Wincheſter, and 110 weſt-by-ſouth of London. W. Long. 2. 0. N. Lat. 50. 42.

POOLE (Matthew), a very learned writer in the 17th century, was born at York in 1624. He was educated at Emanuel-college, Cambridge, and afterwards incorporated in the univerſity of Oxford. He ſucceeded Dr Anthony Tuckney in the rectory of St Michael de Quern, in London, about 1648. In 1658 he ſet on foot a project for maintaining youths of great parts at the univerſities, and had the approbation of the heads of houſes in both of them. He ſolicited the affair with ſo much vigour, that in a ſhort time 900 l. *per annum* was procured for that purpoſe; but this deſign was laid aſide at the Reſtoration. In 1662 he was ejected from his living for nonconformity. He was ten years employed in compoſing his *Synopſis Criticorum*, &c. Beſides this great work he publiſhed ſeveral other pieces. When Dr Oates's depoſitions concerning the popiſh plot were printed, our author found his name in the liſt of thoſe who were to be cut off, on the account (as was ſuppoſed) of what he had written againſt the papiſts in his *Nullity of the Romiſh Faith*. So that he was obliged to retire into Holland, where he died in 1679, and left behind him the character of a very able critic and caſuiſt.

POOP, the ſtern of a ſhip; or the higheſt, uppermoſt, and hinder part of a ſhip's hull. See STERN.

POOR, in law, an appellation given to all thoſe who are in ſuch a low and mean condition, that they either are or may become a burden to the community.

They who rank pity amongſt the original impulſes of our nature rightly contend, that when it prompts us to the relief of human miſery, it indicates ſufficiently the Divine intention, and our duty. Indeed, the ſame concluſion is deducible from the exiſtence of the paſſion, whatever account be given of its origin. Whether it be inſtinct, or a habit founded in aſſociation (ſee PASSION), it is in fact a property of our nature which God appointed: and the final cauſe for which it was appointed is to afford to the miſerable, in the compaſſion of their fellow-creatures, a remedy for thoſe inequalities and diſtreſſes to which many are neceſſarily expoſed under every poſſible rule for the diſtribution of property. That the poor have a claim upon the rich, founded in the law of nature, can be queſtioned by no man who admits the benevolence of the Deity, and conſiders his purpoſe in creating the world (ſee THEOLOGY, Part I. Sect. ii.); and upon this claim the Chriſtian Scriptures are more explicit than almoſt upon any other.

The rights of the poor, however, to be relieved by the rich, as they originate, in nature, and are ſanctioned by Chriſtianity, are evidently of that kind which is called *imperfect* (See MORAL *Philoſophy*, nº 151.) It is ſurely needleſs to warn our readers in this place, that imperfect rights are in themſelves as ſacred, and the duties reſulting from them as obligatory in *foro conſcientiæ*, as the moſt rigid claims of juſtice. Every one knows, that they are called *imperfect* only becauſe the extent of them in particular inſtances cannot be aſcertained by poſitive laws, nor the breach of them be puniſhed by the civil magiſtrate. Hence the apoſtle, tho' he enjoins a weekly contribution to be made for the poor in the church of Corinth, yet leaves the ſum to be contributed by each individual wholly undetermined. "Now concerning the collection for the ſaints, as I have given order to the churches of Galatia, even ſo do ye. Upon the firſt day of the week let every one of you lay by him in ſtore as God hath *proſpered him*." By which St Paul certainly recommends to every man to contribute, not a fixed ſum, but as much as, from a deliberate compariſon of his fortune, with the reaſonable expences and expectations of his family, he finds he can ſpare for charitable purpoſes.

It is well known that thoſe weekly contributions were laid at the feet of the apoſtles, who transferred the management of the fund thence ariſing to deacons elected by the people, and ordained by them to ſee that the money was properly diſtributed. Hence, under Chriſtianity, the maintenance of the poor became chiefly an eccleſiaſtical concern; and when that holy and benevolent religion was eſtabliſhed in the Roman empire, a fourth part of the tithes was in ſome countries of Europe, and particularly in England, ſet apart for that purpoſe. Afterwards, when the tithes of many pariſhes were appropriated to the monaſteries, theſe ſocieties were the principal reſource of the poor, who were farther relieved by voluntary contributions. Judge Blackſtone obſerves, that till the ſtatute 26 Hen. VIII. cap. 26. he finds no compulſory method for providing for the poor; but upon the total diſſolution of the monaſteries, abundance of ſtatutes were made in the reign of King Henry VIII. Edward VI. and Elizabeth, which at laſt eſtabliſhed the

Poor's Rate, or legal aſſeſſment for the ſupport of the poor in England. The ſums that had been appropriated for charitable uſes before the reformation were immenſe, and the wealth that had been accumulated through a ſucceſſion of ages by mendicant orders of religious perſons was inconceivably great; nor was it in the power of any laws to confine men who were in the poſſeſſion of ſuch wealth from gratifying thoſe deſires which money can ſo eaſily find means of ſupplying. Yet among the various abuſes to which this opulence had given riſe, theſe religious orders had never ſo far loſt ſight of their original inſtitution as ever to neglect the poor. Theſe were indeed provided for by them with an indiſcriminate profuſion of largeſſe, better proportioned to their own opulence than to the wants of the claimants, who were too often, without examination, all equally ſerved, whether deſerving or undeſerving of that bounty which they claimed.

When the *religious houſes*, as they were called, were entirely ſuppreſſed at the reformation, and the wealth that belonged to them was diverted into other channels, the poor, who had been in uſe to receive their ſupport from thence, were of courſe left entirely deſtitute; and this ſoon became a grievance ſo intolerable not only to the poor themſelves, but to the whole nation, as to excite an univerſal deſire to have it remedied. Accordingly, by the 14 Eliz. cap. 5. power was given to the juſtices to lay a general aſſeſſment; and this hath continued ever ſince. For by 43 Eliz. cap. 2. the churchwardens and overſeers of the poor of every pariſh, or the greater part of them (with the conſent of two juſtices, one of whom is of the quorum, dwelling in or near the pariſh), are empowered to raiſe weekly, or otherwiſe, by taxation of every inhabitant, parſon, vicar, and other, and of every occupier of lands, houſes, &c. materials for employing the poor, and competent ſums for their relief. Notice ſhall be given in church of every ſuch rate the next Sunday after it is allowed, which may be inſpected by every inhabitant, paying 1s. and copies of it granted on demand, 6d. being paid for every 24 names; and a churchwarden or overſeer refuſing, ſhall forfeit 20 l. to the party aggrieved. The rate is to be levied by diſtreſs on thoſe who refuſe to pay it; and, by 17 Geo. II. cap. 2. cap. 38. appeals againſt it are allowed.

If the juſtices find that the inhabitants of any pariſh are not able to levy among themſelves ſufficient ſums for the purpoſes ſpecified in the act, they may aſſeſs any other pariſh within the hundred; and if the hundred be unable to grant neceſſary relief, they may rate and aſſeſs any pariſh within the county. 43 Eliz. cap. 2.

In order to compel huſbands and parents to maintain their own families, the law hath provided, that all perſons running away out of their pariſhes, and leaving their families upon the pariſh, ſhall be deemed and ſuffer as incorrigible rogues (7 Jac. cap. 4.) And if a perſon merely threatens to run away and leave his wiſe and children upon the pariſh, he ſhall upon conviction, before one juſtice by confeſſion, or oath of one witneſs, be committed to the houſe of correction for any time not exceeding one month (17 Geo. II. cap. 5.) For the farther maintenance of the poor, there are many fines and forfeitures payable to their uſe; as for ſwearing, drunkenneſs, deſtroying the game, &c. And alſo parts of waſtes, woods, and paſtures, may be encloſed for the growth and peſervation of timber and underwood for their relief. See *Work-Houſe*.

The famous ſtatute of the 43d of Elizabeth, which is the baſis of all the poor-laws in England, was conſtructed with a cautious forethought that can perhaps be equalled by few laws that ever were enacted; and if proſpective reaſoning alone were to be relied on in matters of legiſlation, it ſeemed impoſſible to amend it: yet experience has now proved, with a moſt demonſtrative certainty, that it is not ſo ſalutary as was undoubtedly expected.

The perſons who compoſed that law had before their eyes ſuch a recent proof of the abuſe that had been made of the charitable benificence of individuals, that they ſeem to have been chiefly ſolicitous to obviate ſimilar abuſes in future; and to guard againſt that partial kind of ſeduction, they rather chooſe to eſtabliſh a deſpotic power which ſhould be authorized to wreſt from every individual in the nation whatever ſums it might think proper to call for, truſting to a few feeble devices which they contrived, for curbing that power which was virtually armed with force ſufficient to ſet all theſe aſide whenever it pleaſed. The conſequence has been, that the ſums levied for the relief of the poor, which were at firſt but ſmall are now enormous, and that the demands are increaſing in ſuch a rapid manner as to give riſe to the moſt ſerious and well-grounded apprehenſions. In the year 1774, parliament inſtituted an inquiry into the amount of the poor's-rates in England and Wales, and again in 1783 On comparing theſe together, the riſe during that ſhort period was found to be in England upwards of 850,000 l. *per annum*, being nearly in the proportion of one-third of the rate at the firſt period. In Wales, during the ſame period of time, the rates were more than doubled. Nor was this a temporary ſtart, but a part only of a gradual progreſſion. Mr Wenderdon, in his View of England, obſerves, that "in the year 1680 the poor's-rates produced no more than 665,390 l. in 1764 they ſtood at 1,200,000 l. and in 1773 they were eſtimated at 3,000,000 l." It is a known fact (ſays Mr Beaufoy, in the debate on Mr Gilbert's poor bill, April 17th 1788), that within the laſt nine years, the poor's-rates have increaſed one-third, and ſhould they continue increaſing in the ſame proportion for 50 or 53 years they would amount to the enormous ſum of 11,230,000 l. a burden which the country could not poſſibly bear. It was therefore, he added, highly neceſſary that ſomething ſhould be attempted to prevent this alarming addition, if not to annihilate the preſent glaring miſconduct in the management of the poor."

Such has been the fate of England with regard to poor laws.

In Scotland, the reformation having been carried forward with a ſtill more violent precipitancy than in England, and the funds of the regular clergy being more entirely alienated, the caſe of the poor there became ſtill more ſeemingly deſperate, and the clamours were alſo there conſiderable at that time. Then alſo it was that the Scottiſh court, imitating as uſual at that time the practice of England, made ſeveral feeble attempts to introduce a ſyſtem of compulſory poor's-rates into that country, but never digeſted the ſyſtem ſo thoroughly as to form a law that could in any caſe be carried into effect. Many crude laws on this head were indeed enacted; but all of them ſo evidently inadequate for the purpoſe, that they never were, even in one inſtance that we have heard of, attempted at the time to be carried into effect. Indeed it ſeems to have been impoſſible to carry them into effect; for they are all ſo abſurd and contradictory to each other, that hardly a ſingle clauſe of any one of them can be obeyed without tranſgreſſing others of equal importance.

The laſt ſtatute which in Scotland was enacted on this ſubject bears date September 1ſt 1691, William and Mary, parl. 1. ſeſſ. 7. chap. 21. and it "ratifies and approves *all* former acts of parliament and proclamations of council for repreſſing of beggars, and maintaining and employing the poor." If this law therefore were now in force, and it never was repealed, no perſon could with impunity countervail any one of thoſe ſtatutes which it ratifies; but to be convinced how impoſſible it is to obſerve them all, the attentive reader needs only to conſider thoſe laws and proclamations with reſpect to the following particulars, *viz.*

1. *The perſons appointed to make up the poor's roll.* By the act 1579 this duty is entruſted to the provoſt and bailies within burgh, and the judge conſtitute be the king's commiſſion in paroches to landwart. By act 1663, it is the heritors of each pariſh. By act 1672, it is the miniſters and elders of each pariſh who are to make up this liſt. By the proclamation of 1692, it is the heritors, miniſters, and elders of every pariſh. By that of 1693, it is the magiſtrates of royal burghs, and the heritors of vacant [country] pariſhes; in both caſes without either miniſter or elders. Among this chaos of contradictions how it is poſſible to act without tranſgreſſing ſome law.

2. Not leſs contradictory are the enactments in regard *to the perſons who are to pay*, and the mode of apportioning the ſums among them. By act 1579, the haill inhabitants of the parochin ſhall be taxed and ſtented according to the eſtimation of their ſubſtance, without exception of perſons. By that of 1663, the one-half is to be paid by the heritors, and the other half by the tenants and poſſeſſors, according to their means and ſubſtance. By the proclamation of 1692, the one-half is

to be paid by the heritors, the other by the houſeholders of the pariſh. By that of 1693, in burghs royal, the magiſtrates are to ſtent themſelves, conform to ſuch order and cuſtom uſed and wont in laying on ſtents, annuities, or other public burdens, in the reſpective burgh, as may be moſt effectual to reach all the inhabitants; and the heritors of ſeveral vacant [landwart] pariſhes to ſtent themſelves for the maintenance of the reſpective poor.

3. A ſtill greater diverſity takes place in regard to the *application of the ſums ſo ſtented*. By the act 1579, it would ſeem that the whole of the money aſſeſſed was to be applied to the uſe of the helpleſs poor alone, and no part of it for the relief of thoſe who were capable of working. By the act 1663, on the contrary, the whole of this aſſeſſment is to be applied for the ſupport of thoſe *only who are able to work*. This is ſtill more ſpecially provided for by the act 1672; where the poor who are unable to work are to be ſupported by the weekly collections at the kirk doors; and the ſtented aſſeſſments to be applied to the ſupport of thoſe in the correction houſes.

It would be tireſome to enumerate all the contradictions that theſe laws authoriſe. In regard *to the perſons who are required to carry theſe acts into execution*, it is at different times the chancellor; magiſtrates; commiſſioners of exciſe; ſheriffs; juſtices of the peace; miniſters and elders; the preſbyteries; heritors, miniſters, and elders; heritors alone; commiſſioners nominated by preſbyteries and appointed by the king; the lords of the privy council: in ſhort, no two laws can be found that do not vary from each other in this reſpect one way or other.

The ſame variations take place with regard to the building of correction-houſes, confinement and puniſhment of vagrants, application of their work, awarding their ſervices and thoſe of children. In ſhort, there is not one particular in which theſe laws do not vary from and contradict each other; ſo that, let any perſon try to act in virtue of any one of them, it is impoſſible for him to avoid going in direct oppoſition to the enactments of ſome other law which is of equal force with that he has choſen for his guide. In theſe circumſtances it is ſo far from being ſurpriſing that theſe acts have been ſuffered to remain in perpetual deſuetude, that it would have been truly wonderful if this had not been the caſe. They have, however, been permitted to remain on the ſtatute-book as a diſgrace to the times when they were formed, and, as a ſtumbling-block to thoſe that were to follow. That not one of them is now in force was lately proved by a learned and public-ſpirited gentleman, to whom his country is on that and many other accounts deeply indebted. Refuſing to pay the poor's tax, with which he was aſſeſſed by the overſeers of the pariſh in which he happened to reſide, he ſtood an action in the court of ſeſſion, and prevailed, upon the broad ground, *that there is no law* IN FORCE *in Scotland by which an* INVOLUNTARY *poor's rate can be eſtabliſhed in any pariſh*.

But how, it will be aſked by our readers, are the poor in Scotland really maintained? We anſwer, by the private alms of individuals, and by certain funds under the management of the *kirk-ſeſſions* (ſee PRESBYTERIANS). It is the univerſal practice, each Lord's day, in every pariſh, for ſuch of the audience as are in eaſy circumſtances, to give to the poor ſuch an offering of alms as they ſhall deem proper. This offering is generally dropped into a baſon placed at the church-door, and under the immediate care of an elder. When the ſervice is begun, the elder removes with the baſon, which he keeps under his charge till the congregation be diſmiſſed. The ſeſſion then meets, and the money is told over, its amount marked down in the ſeſſion account book, and depoſited in a box kept for that purpoſe. This box has uſually a ſmall ſlit in the top, through which the pieces of money can be dropped without opening it; and it is cloſed with two locks, the key of one of which is uſually kept by the miniſter and the other by the kirk-treaſurer, ſo that it can never be opened but in the preſence of theſe two at leaſt.

A kirk-ſeſſion, when regularly conſtituted, muſt always conſiſt of the miniſter, elders, ſeſſion-clerk, and kirk-treaſurer. None of theſe ever receive any ſalary except the ſeſſion-clerk, who is uſually the ſchoolmaſter of the pariſh, and has a ſmall ſalary allowed for minuting the tranſactions. The kirk-treaſurer is for the moſt part one of the elders; and he is an important member of this court. Without his intervention no diſtribution of the poor's funds is deemed legal; nor can any payments be made, receipts granted, or money transferred, but by him; the miniſter and ſeſſion being perſonally liable to make good all money that may otherwiſe be given away, ſhould it ever afterwards be challenged by any heritor in the pariſh.

The precautions taken for the diſtribution of the poor's funds are likewiſe ſimple and excellent, and are as follow.

No money can be legally iſſued from the poor's funds even by the treaſurer and ſeſſion, unleſs legal proof can be brought that public intimation has been given from the pulpit immediately after divine ſervice, and before the congregation has diſperſed, that a diſtribution of poor's money is to be made by the ſeſſion, at ſuch a time and place, ſpecifying the ſame, and inviting all who have intereſt in the caſe to attend if they ſhall incline. This intimation muſt be made a full fortnight before the time of diſtribution; and as every heritor (owner of landed property) in the pariſh has a right to vote in the diſtribution of the poor's funds, they may all, if they ſo incline, then attend and exerciſe that right: but if none of them ſhould attend, which is often the caſe, the ſeſſion has then a right to proceed; and whatever they ſhall thus do, is deemed ſtrictly legal, and is liable to no challenge. But ſhould they proceed without having given this previous intimation, they may, if the heritors ſhould afterwards challenge it, be made to repay out of their own pockets every ſhilling they ſhall have ſo iſſued. It ſometimes happens, that young miniſters, through heedleſſneſs in this reſpect, expoſe themſelves and families to conſiderable trouble and loſs, which by attention might be eaſily avoided. In the ſame way, ſhould a miniſter and ſeſſion, without the intervention of a treaſurer regularly conſtituted, lend upon bond or otherwiſe any of the poor's funds, and ſhould the perſon ſo borrowing afterwards fail, theſe lenders are perſonally liable to make good the whole, and any heritor in the pariſh who chooſes it can compel him to do ſo.

The members of the ſeſſion are alſo liable to pay all loſſes, and to account for all ſums that it can be inſtructed they received, if they neglect to keep regular books, in which every tranſaction ſhall be entered: Or, if theſe books have not been reviſed and approved of by the preſbytery (A); but if they ſhall have been ſo reviſed, they cannot be challenged for omiſſion of forms, and can only be made to account for errors, or frauds, or evident dilapidations.

Under this wiſe and economical ſyſtem of management, it has been found by the experience of more than 200 years, that in the low parts of the country, where the pariſhes are in general of ſuch moderate extent as to admit of the people of every part of the pariſh generally to attend divine ſervice every Lord's day, the ordinary funds have been amply ſufficient to ſupply all the real demands of the poor, and in moſt pariſhes a fund has been accumulated from the ſavings of ordinary years to help the deficiencies that may ariſe in years of uncommon ſcarcity.

Beſides the weekly collections, the extra offerings at the adminiſtration of the Lord's ſupper, the pious donations of charitable individuals, which are all voluntary, together with ſome ſmall fees paid for the uſe of a *mortcloth* (a black velvet pall) at funerals, which is generally purchaſed with the poor's money, go to make up this parochial fund. Nor muſt any one believe that the money which comes through the hands of the adminiſtrators of the poor's funds is all that is beſtowed upon the poor in Scotland; far from it: there are a thouſand other channels through which the indigent derive conſolation and ſupport, all of them tending to produce the happieſt effects upon ſociety. A ſon feels himſelf aſhamed to think that his parents ſhould require the aſſiſtance of another to ſupport them; he therefore ſtrains every nerve when in the vigour of life to ſpare a little of his earning to render their old age more eaſy than it might have been; and ſweet to a parent is the bread that is given by the pious attention of a child. If there are ſeveral children, they become emulous who ſhall diſcover moſt kindneſs. It is a pious contention which ſerves to unite them the cloſer to each other, by commanding their mutual eſteem.

Directly contrary to this is the effect of the poor laws of England, where, in London at leaſt, it is not uncommon to ſee men in good buſineſs neglecting their aged and diſeaſed parents for no better reaſon than that the pariſh is bound to find them bread. Theſe laws have other pernicious conſequences; for they are obviouſly ſubverſive of induſtry as well as morality among the lower orders of the people. "This is a heavy charge, but no leſs true than heavy. Fear of want is the only effectual motive to induſtry with the labouring poor: remove that fear, and they ceaſe to be induſtrious. The ruling paſſion of thoſe who live by bodily labour, is to ſave a pittance for their children, and for ſupporting themſelves in old age. Stimulated by deſire of accompliſhing thoſe ends, they are frugal and induſtrious; and the proſpect of ſucceſs is a continual feaſt to them. Now, what worſe can malice invent againſt ſuch a man, under colour of friendſhip, than to ſecure bread to him and his children whenever he takes a diſlike to work; which effectually deadens his ſole ambition, and with it his honeſt induſtry? Relying on the certainty of a proviſion againſt want, he relaxes gradually till he ſinks into idleneſs; idleneſs leads to profligacy; profligacy begets diſeaſes; and the wretch becomes an object of public charity before he has run half his courſe. Wiſely therefore is it ordered by Providence, that charity ſhould in every inſtance be voluntary, to prevent the idle and profligate from depending on it for ſupport. During the reign of Elizabeth, when the monaſteries were recently ſuppreſſed, and all their revenues ſquandered, ſome compulſion might be neceſſary to prevent the poor from ſtarving. A temporary proviſion for this purpoſe, ſo contrived as not to ſuperſede voluntary charity, but rather to promote it, would have been a meaſure extremely proper. Unlucky it is for England that ſuch a meaſure was overlooked; but the queen and her parliaments had not the talent of foreſeeing conſequences without the aid of experience. A perpetual tax for the poor was impoſed, the moſt pernicious tax, ſays Lord Kames (B), that ever was impoſed in any country."

POPA-MADRE, is a town of South America, in Terra Firma. In this place there is a convent and chapel dedicated to the Virgin Mary, to whoſe image the Spaniards in thoſe parts go in pilgrimage, particularly thoſe who have been at ſea. It is ſeated on a high mountain, 50 miles eaſt of Carthagena. W. Long. 74. 32. N. Lat. 10. 15.

POPÆ. See VICTIMARIUS.

POPAYAN, a province of South America, in the kingdom of New Granada, between the audience of Panama, that of Quito, and the South Sea; 400 miles in length, and 300 in breadth. A chain of barren mountains runs through the country from north to ſouth; and near the ſea the ſoil is ſo ſoaked with almoſt continual rains, that few care to reſide there, except for the ſake of the gold that is met with in great plenty in the ſands of the rivulets. This bewitching metal brings many in ſearch of it, though it is a great doubt whether they ever return back alive or not. For this reaſon the ſavage Americans are ſtill maſters of a great part of it, and continually annoy the Spaniards.

POPAYAN, the capital town of a province of that name in South America, with a biſhop's ſee, a Spaniſh governor, and where the courts of juſtice are held. The inhabitants are almoſt all Creoles. It is 220 miles north-eaſt of Quito. W. Long. 75. 55. N. Lat. 2. 35.

POPE, a name which comes from the Greek word Παπα, and ſignifies *Father*. In the eaſt this appellation is given to all Chriſtian prieſts; and in the weſt, biſhops were called by it in ancient times: but now for

many

(A) The preſbytery is by law appointed auditor of the poor's accounts of the ſeveral pariſhes within its bounds; and if they find any difficult caſe occur in the diſcharge of this duty, they may lay it before the ſynod for advice.

(B) See *Sketches of Man*, book ii. ſketch 10. where many other arguments equally forcible are urged againſt all involuntary *poor-rates*, and where many ingenious expedients are propoſed for gradually aboliſhing them where they are eſtabliſhed.

many centuries it has been appropriated to the biſhop of Rome, whom the Roman Catholics look upon as the common father of all Chriſtians.

Much has been ſaid, much written, and many warm diſputes have been carried on concerning the pope, and the power belonging to him, within theſe two or three laſt centuries. We ſhall here, without entering into controverſy, lay down diſtinctly, from the beſt authority, what the Roman Catholics really believe concerning the *pope*, after having deſcribed the manner of his election; and we ſhall give ſome other particulars relating to this ſubject that ſeem to deſerve notice, and are in this country not generally known.

All in communion with the ſee of Rome unanimouſly hold, that our Saviour Jeſus Chriſt conſtituted St Peter the apoſtle chief paſtor under himſelf, to watch over his whole flock here on earth, and to preſerve the unity of it; giving him the power requiſite for theſe ends. They alſo believe, that our Saviour ordained, that St Peter ſhould have ſucceſſors with the like charge and power, to the end of time. Now, as St Peter reſided at Rome for many years, and ſuffered martyrdom there, they conſider the biſhops of Rome as his ſucceſſors in the dignity and office of the univerſal paſtor of the whole Catholic church. There have been ſome varieties in the manner of chooſing the biſhop of Rome in different ages, as alterations may be made in diſcipline; but ſtill the clergy of Rome have juſtly had the chief part in that election: and that clergy is now repreſented by, or in ſome manner conſiſts of, *the cardinals*, who have for ſeveral centuries been the ſole electors of the pope.

Theſe *cardinals* or *principal perſons* of the church of Rome are 70 in number, when the *ſacred college*, as it is called, is complete. Of theſe ſix are cardinal biſhops, the biſhops of Oſtia, of Porto, Albano, Sabino, Tuſculum or Fraſcati, and Præneſte or Paleſtrina; which are the ſix ſuburbicarian churches; fifty are cardinal prieſts, who have all titles from pariſh churches in Rome; and fourteen are cardinal deacons, who have their titles from churches in Rome of leſs note, called *Diaconias* or *Deaconries*. Theſe cardinals are created by the pope when there happen to be vacancies; and ſometimes he names one or two only at a time; but commonly he defers the promotion until there be ten or twelve vacancies or more; and then at every ſecond ſuch promotion the emperor, the kings of Spain and France, and of Britain, when Catholic, are allowed to preſent one each, to be made cardinal, whom the pope always admits if there be not ſome very great and evident objection. Theſe cardinals are commonly promoted from among ſuch clergymen as have borne offices in the Roman court; ſome are aſſumed from religious orders; eminent eccleſiaſtics of other countries are likewiſe often honoured with this dignity, as the archbiſhops of Toledo and Vienna are at preſent cardinal prieſts of Rome. Sons of ſovereign princes have frequently been members of the ſacred college; and there ends the direct line of the royal family of Stuart. Their diſtinctive dreſs is ſcarlet, to ſignify that they ought to be ready to ſhed their blood for the faith and church, when the defence and honour of either require it. They wear a ſcarlet cap and hat: the cap is given to them by the pope if they are at Rome, and is ſent to them if they are abſent; but the hat is never given but by the pope's own hand. Theſe cardinals form the pope's ſtanding council or *conſiſtory* for the management of the public affairs of church and ſtate. They are divided into different *congregations* for the more eaſy diſpatch of buſineſs; and ſome of them have the principal offices in the pontifical court, as that of cardinal-vicar—penitentiary—chancellor—camerlingo or chamberlain—perfect of the ſignature of juſtice—perfect of memorials—and ſecretary of ſtate. They have the title given them of *eminence* and *moſt eminent*. But here we conſider them principally as the perſons entruſted with the choice of the pope. See Cardinal.

On the demiſe of a pope his pontifical ſeal is immediately broken by the chamberlain, and all public buſineſs is enterrupted that can be delayed: meſſengers are diſpatched to all the Catholic ſovereigns to acquaint them of the event, that they may take what meaſures they think proper; and that the cardinals in their dominions, if any there be, may haſten to the future election if they chooſe to attend; whilſt the whole attention of the ſacred cellege is turned to the preſervation of tranquillity in the city and ſtate, and to the neceſſary preparations for the future election. The cardinal chamberlain has, during the vacancy of the holy ſee, great authority; he coins money with his own arms on it, lodges in the pope's apartments, and is attended by body-guards. He, and the firſt cardinal biſhop, the firſt cardinal prieſt, and the firſt cardinal deacon, have, during that time, the government almoſt entirely in their hands. The body of the deceaſed pope is carried to St Peter's, where funeral ſervice is performed for him with great pomp for nine days, and the cardinals attend there every morning. In the mean time, all neceſſary preparations for the election are made; and the place where they aſſemble for that purpoſe, which is called the *conclave*, is fitted up in that part of the Vatican palace which is neareſt to St Peter's church, as this has long been thought the moſt convenient ſituation. Here is formed by partitions of wood a number of cells or chambers equal to the number of cardinals, with a ſmall diſtance between every two, and a broad gallery before them. A number is put on every cell, and ſmall papers with correſponding numbers are put into a box: every cardinal, or ſome one for him, draws out one of theſe papers, which determines in what cell he is to lodge. The cells are lined with cloth; and there is a part of each one ſeparated for the conclaviſts or attendants, of whom two are allowed to each cardinal, and three to cardinal princes. They are perſons of ſome rank, and generally of great confidence; but they muſt carry in their maſter's meals, ſerve him at table, and perform all the offices of a menial ſervant. Two phyſicians, two ſurgeons, an apothecary, and ſome other neceſſary officers, are choſen for the conclave by the cardinals.

On the 10th day after the pope's death the cardinals, who are then at Rome, and in a competent ſtate of health, meet in the chapel of St Peter's, which is called the *Gregorian chapel*, where a ſermon on the choice of a pope is preached to them, and maſs is ſaid for invoking the grace of the Holy Ghoſt. Then the cardinals proceed to the conclave in proceſſion two by two, and take up their abode. When all is properly ſettled, the conclave is ſhut up, having boxed *wheels* or places of communication in convenient quarters: there are alſo ſtrong guards placed all around. When any foreign cardinal arrives after the incloſure, the conclave is opened for his admiſſion. In the beginning every cardinal ſigns a paper, containing an obligation, that if he ſhall be raiſed to the papal chair he will not alienate any part of the pontifical dominion; that he will not be prodigal to his relations; and any other ſuch ſtipulations as may have been ſettled in former times or framed for that occaſion.

We come now to the election itſelf; and that this muſt be effectual, two thirds of the cardinals preſent muſt vote for the ſame perſon. As this is often not eaſily obtained, they ſometimes remain whole months in the conclave. They meet in the chapel twice every day for giving their votes; and the election may be effectual by *ſcrutiny*, *acceſſion*, or *acclamation*. Scrutiny is the ordinary method; and conſiſts in this: every cardinal writes his own name on the inner part of a piece of paper, and this is folded up and ſealed; on a ſecond fold of the ſame paper a conclaviſt writes the name of the perſon for whom his maſter votes. This, according to agreements obſerved for ſome centuries, muſt be one of the ſacred college. On the outer ſide of the paper is written a ſentence at random, which the voter muſt well remember. Every cardinal, on entering into the chapel, goes to the altar and puts his paper into a large chalice.

When all are convened, two cardinals number the votes; and if there are more or leſs than the number of cardinals preſent, the voting muſt be repeated. When that is not the caſe, the cardinal appointed for the purpoſe reads the outer ſentence, and the name of the cardinal under it, ſo that each voter hearing his own ſentence and the name joined with it, knows that there is no miſtake. The names of all the cardinals that are voted for are taken down in writing, with the number of votes for each; and when it appears that any one has two-thirds of the number preſent in his favour the election is over: but when this does not happen, the voting papers are all immediately burnt without opening up the inner part. When ſeveral trials of coming to a concluſion by this method of *ſcrutiny* have been made in vain, recourſe is ſometimes had to what is called *acceſſion*. By it, when a cardinal perceives that one or very few votes are wanting to any one for whom he had not voted at that time, he may ſay that he *accedes* to the one who has near the number of votes requiſite; and if his one vote ſuffices to make up the two-thirds, or if he is followed by a ſufficient number of *acceders* or new voters for the ſaid cardinal, the election is accompliſhed. Laſtly, a pope is ſometimes elected by *acclamation*; and that is, when a cardinal, being pretty ſure that he will be joined by a number ſufficient, cries out in the open chapel, that ſuch an one ſhall be pope. If he is ſupported properly, the election becomes unanimous; thoſe who would perhaps oppoſe it foreſeeing that their oppoſition would be fruitleſs, and rather hurtful to themſelves. It is to be obſerved, that the emperor of Germany and the kings of France and Spain claim a right of excluding one cardinal from being pope at every election. Hence, when the ambaſſador at Rome of any of theſe ſovereigns perceives that any cardinal, diſagreeable to his maſter, according to the inſtructions he has received, is like to be made pope, he demands an audience of the conclave, is admitted, and there declares his maſter's will, which is always attended to for the common good. But each of thoſe ſovereigns is allowed thus to exclude only one at one time; and they unwillingly and ſeldom put this right in execution.

When a pope is choſen in any of the three abovementioned ways, the election is immediately announced from the balcony in the front of St Peter's, homage is paid to the new pontiff, and couriers are ſent off with the news to all parts of Chriſtendom. The pope appoints a day for his coronation at St Peter's, and for his taking poſſeſſion of the patriarchal church of St John Lateran; all which is performed with great ſolemnity. He is addreſſed by the expreſſion of *Holineſs*, and *moſt holy Father*.

Let us now proceed to ſee what authority Roman Catholics attribute to the pope thus choſen. They believe, then, that the biſhop of Rome is, under Chriſt, ſupreme paſtor of the whole church; and as ſuch is not only the firſt biſhop in order and dignity, but has alſo a power and juriſdiction over all Chriſtians, in order to preſerve unity and purity of faith and moral doctrine, and to maintain order and regularity in all churches. Wherefore they hold, that when the pope underſtands that any error has been broached againſt faith or manners, or that any conſiderable difference on ſuch ſubjects has ariſen in any part of Chriſtendom, it belongs to him, after due deliberation and conſultation, to iſſue out his paſtoral decree, condemning the error, clearing up the doubt, and declaring what has been delivered down, and what is to be believed. Some Catholic divines are of opinion that the pope cannot err, when he thus addreſſes himſelf *to all the faithful* on matters of doctrine. They well know, that as a private doctor he may fall into miſtakes as well as any other man; but they think, that when he teaches the whole church Providence muſt preſerve him from error; and they apprehend, that this may be deduced from the promiſes of Chriſt to St Peter, and from the writings of the ancient fathers. However, this infallibility of the pope, even when he pronounces in the moſt ſolemn manner, is only an opinion, and not an article of Roman Catholic faith. Wherefore, when he ſends for the doctrinal decrees, the other biſhops, who are alſo guardians of the faith in an inferior degree, may, with due reſpect, examine theſe decrees; and if they ſee them agree with what has been always taught, they either formally ſignify their acceptance, or they tacitly acquieſce, which, conſidering their duty, is equivalent to a formal approbation. When the acceptation of the generality of the biſhops has been obtained, either immediately or after ſome mutual correſpondence and explanation, the decrees of the pope thus accepted come to be the ſentence of the whole church, and are believed to be beyond the poſſibility of error!

Sometimes it may happen that the diſputes and difference may be ſo great and intricate, that to the end it may be ſeen more clearly what has really been delivered down; and to give all poſſible ſatisfaction, it may appear proper to convene all the biſhops who can conveniently attend to one place, to learn from them more diſtinctly what has been taught and held in their reſpective churches. Roman Catholics believe that it belongs to the pope to call ſuch general councils, and to preſide in them in perſon or by his legates. They likewiſe hold, that when the pope has approved the decrees of ſuch councils concerning faith or manners, ſuch decrees are then final, and muſt be received as ſuch by all Catholics. In all this they believe, that the particular aſſiſtance of the Holy Ghoſt is with the paſtors of the church, that ſo *the gates of hell may never prevail againſt her.*

The ſee of Rome, according to Roman Catholics, is the centre of Catholic unity. All their biſhops communicate with the pope, and by his means with one another, and ſo form one body. However diſtant their particular churches may be, they all meet at Rome either in perſon or by their delegates, or at leaſt by their letters. And, according to the diſcipline of the latter ages, though they are preſented to the pope for their office from their reſpective countries, yet from him they muſt receive their bulls of conſecration before they can take poſſeſſion of their ſees.

In matters of church diſcipline, the pope, as chief paſtor, not only ought to take care that the canons actually in force be obſerved in all churches, but he may alſo make new canons and regulations when he ſees it neceſſary or expedient for the ſpiritual benefit of the faithful, according to times and circumſtances. But in doing this he muſt not infringe the eſtabliſhed rights or cuſtoms with injury to any perſon; which if, through miſtake or wrong information, he ſhould ever do, the perſons who think themſelves aggrieved may remonſtrate with reſpect and ſue for redreſs. He may eſtabliſh new epiſcopal ſees, where there have been none before; and he may alter the limits of former dioceſes; but in ſuch alterations he always of courſe conſults the temporal ſovereign, if in communion with him. He ſends paſtors to preach the goſpel to all countries where the Catholic religion is not by law eſtabliſhed; and to him appeals may be made from all parts of Chriſtendom in eccleſiaſtical cauſes of great importance.

The pope may diſpenſe with the obſervation of eccleſiaſtical canons when there are juſt reaſons for it, as may frequently happen; he may alſo diſpenſe with vows when they are made with that expreſs or tacit condition (A) that he really may diſpenſe with them; he may alſo on ſome occaſions declare that obligations have really ceaſed when that is truly the caſe, from a great alteration of circumſtances: But he can never grant any diſpenſation, to the injury of any third perſon, and can never allow any one to do what is unjuſt, or to ſay what he knows to be falſe, whatever advantage might be expected from it.

The pope is alſo a temporal prince, and poſſeſſes conſiderable dominions in the middle part of Italy, beſides Avignon, which the French have lately taken from him, and the duchy of Benevento incloſed within the kingdom of Naples. It is alſo ſuppoſed that the kingdom of Naples and Sicily, and the duchies of Parma and Placentia, are ſtill held of him in fief as they were before. His predeceſſors have acquired theſe poſſeſſions at different times and on different occaſions, by various donations, conceſſions, treaties, and agreements, in like manner as has happened with regard to the eſtabliſhment of other ſovereignties; and his title to them is like to that of other potentates to their reſpective poſſeſſions. The revenue ariſing from this eſtate, and what he receives for various reaſons from Catholic countries, which is now much reduced, is employed for the ſupport of government, in ſalaries to the officers of his court, for the education of clergymen, and for the maintaining of miſſionaries in infidel countries. Great ſums are particularly expended for the propagation of the Chriſtian faith in different parts of Aſia, eſpecially in Armenia, Syria, and China. Nor is it much to be wondered at, if the families, of which the ſovereign pontiffs happen to have been born, acquire greater riches and ſplendor from that connection. The princely families of Barberini, Borgheſe, Chigi, Corſini, Albani, are examples of this kind; but regulations have been made in later times to prevent exceſſive nepotiſm. Beyond the limits of his own temporal dominions the pope has no temporal power or juriſdiction, excepting what any nation may be pleaſed to allow him: when any thing of that kind has been granted or brought in by cuſtom, it is evident that it ought not to be taken away raſhly nor without juſt reaſon. But, as chief paſtor of the church, he has no right to any temporal juriſdiction over his flock. As ſuch, his power is entirely ſpiritual, and has no means of coercion originally or neceſſarily connected with it, but only eccleſiaſtical cenſures. It muſt be owned, that the popes, in ſome ages, ſometimes imagining that they could do much good, ſometimes by the conſent, or even at the deſire, of the ſovereigns, and ſometimes no doubt out of ambitious views, have interfered a great deal in the temporal affairs of the different kingdoms of Europe, which has frequently given ſcandal and done harm to religion. But it is known to thoſe moſt verſant in hiſtory, that their faults of this kind have been exaggerated, and their conduct often miſunderſtood or miſrepreſented. However, in this a Roman Catholic is not obliged to approve what they have done; nay, without acting contrary to his religion, he may judge of them freely, and blame them if he think they deſerve it; only he will do it with reſpect and regret. Thus a Roman Catholic may either apologiſe, if he think he can do it, for the conduct of Innocent III. in depoſing king John of England; or, without being guilty of any offence againſt his religion, he may blame the pontiff for what he did on that occaſion; becauſe the power of the pope to depoſe princes, or to abſolve ſubjects from their allegiance, was never propoſed as an article of faith, or made a term of communion with the church of Rome. Some Catholic divines, indeed, eſpecially among the Jeſuits, are univerſally known to have held this extravagant and dangerous opinion; but by far the greater part of them condemn and abhor it as abſurd and impious: and ſurely it is but fair and juſt to allow them to know beſt what they themſelves believe. And here, to conclude, we ſhall add, that it is very deſirable that Chriſtians of all denominations endeavour to underſtand one another better than they have often done; and inſtead of ſuppoſing imaginary differences, ſtrive to remove real ones, for the general good of mankind, for the glory of God, and honour of religion; and that all vie with one another to excel in juſt and charitable ſentiments, language, and behaviour.

(A) Any other man may unqueſtionably do the ſame when they are made with that expreſs condition.

The reader, who wiſhes to know what can be urged for and againſt the ſupremacy of pope, and who is fitted by his knowledge of eccleſiaſtical hiſtory to underſtand the nature of the queſtion at iſſue, may conſult, on the one hand, the works of Bellarmine, together with a ſmal tract lately publiſhed in Engliſh, under the title of *The Divine Economy of Chriſt in his kingdom or Church;* and on the other, Barrow's treatiſe *on the Pope's Supremacy*, together with Chillingworth's *Religion of Proteſtants*, &c.

Pope (Alexander), a celebrated Engliſh poet, was deſcended from good families, and born the 8th of June 1688, at London, where his father was then a conſiderable merchant. He was taught to read very early by an aunt; and learned to write without any aſſiſtance, by copying printed books. The family being of the Romiſh religion, he was put, at eight years of age, under one Taverner, a prieſt, who taught him the rudiments of the Latin and Greek tongues together; and ſoon after was ſent to a Popiſh ſeminary at Wincheſter, from whence he was removed to a ſchool at Hyde-Park Corner. He diſcovered early an inclination to verſifying; and the tranſlations of Ogilby and Sandys from Virgil and Ovid firſt falling in his way, they were his favourite authors. At twelve he retired with his parents to Binfield, in Windſor Foreſt; and there became acquainted with the writings of Spenſer, Waller, and Dryden. Dryden ſtruck him moſt, probably becauſe the caſt of that poet was moſt congenial with his own; and therefore he not only ſtudied his works intenſely, but ever after mentioned him with a kind of rapturous veneration. He once obtained a ſight of him at a coffee-houſe, but never was known to him: a misfortune which he laments in theſe ſhort but expreſſive words, *Virgilium tantum vidi*. Though Pope had been under more tutors than one, yet it ſeems they were ſo inſufficient for the purpoſe of teaching, that he had learned very little from them: ſo that, being obliged afterwards to begin all over again, he may juſtly be conſidered as one of the *αυτοδιδακτοι* or *ſelf-taught*. At fifteen he had acquired a readineſs in the two learned languages; to which he ſoon after added the French and Italian. He had already ſcribbled a great deal of poetry in various ways; and this year ſet about an epic poem called *Alcander*. He long after communicated it to Atterbury, with a declared intention to burn it; and that friend concurred with him: "Though (adds he) I would have interceded for the firſt page, and put it, with your leave, among my curioſities." What the poet himſelf obſerves upon theſe early pieces is agreeable enough; and ſhows, that though at firſt a little intoxicated with the waters of Helicon, he afterwards arrived to great ſobriety of thinking. "I confeſs (ſays he) there was a time when I was in love with myſelf; and my firſt productions where the children of Self-love upon Innocence. I had made an epic poem, and panegyrics on all the princes; and I thought myſelf the greateſt genius that ever was. I cannot but regret theſe delightful viſions of my childhood, which like the fine colours we ſee when our eyes are ſhut, are vaniſhed for ever." His paſtorals, begun in 1704, firſt introduced him to the wits of the time; among which were Wycherly and Walſh. This laſt gentleman proved a ſincere friend to him; and ſoon diſcerning that his talent lay, not ſo much in ſtriking out new thoughts of his own, as in improving thoſe of other men, and in an eaſy verſification, told him, among other things, that there was one way left open for him to excel his predeceſſors in, which was correctneſs: obſerving, that though we had ſeveral great poets, yet none of them were correct. Pope took the hint, and turned it to good account; for no doubt the diſtinguiſhing harmony of his numbers was in a great meaſure owing to it. The ſame year, 1704, he wrote the firſt part of his Windſor Foreſt, though the whole was not publiſhed till 1710. In 1708, he wrote the Eſſay on Criticiſm: which production was juſtly eſteemed a maſterpiece in its kind, and ſhowed not only the peculiar turn of his talents, but that thoſe talents, young as he was, were ripened into perfection. He was not yet twenty years old; and yet the maturity of judgment, the knowledge of the world, and the penetration into human nature, diſplayed in that piece, were ſuch as would have done honour to the greateſt abilities and experience. But whatever may be the merit of the Eſſay on Criticiſm, it was ſtill ſurpaſſed, in a poetical view, by the Rape of the Lock, firſt completely publiſhed in 1712. The former excelled in the didactic way, for which he was peculiarly formed; a clear head, ſtrong ſenſe, and a ſound judgment, being his characteriſtical qualities; but it is the creative power of the imagination that conſtitutes what is properly called a *poet;* and therefore it is in the Rape of the Lock that Pope principally appears one, there being more *vis imaginandi* diſplayed in this poem than perhaps in all his other works put together. In 1715, he gave out propoſals for publiſhing a tranſlation of Homer's Iliad, by ſubſcription; in which all parties concurred ſo heartily, that he acquired a conſiderable fortune by it. The ſubſcription amounted to 6000 l. beſides 1200 l. which Lintot the bookſeller gave him for the copy. Pope's finances being now in good condition, he purchaſed a houſe at Twickenham, whither he removed with his father and mother in 1715: where the former died about two years after. As he was a Papiſt, he could not purchaſe, nor put his money to intereſt on real ſecurity; and as he adhered to the cauſe of King James, he made it a point of conſcience not to lend it to the new government; ſo that, though he was worth near 20,000 l. when he laid aſide buſineſs, yet, living afterwards upon the quick ſtock, he left but a ſlender ſubſiſtance to his family. Our poet, however, did not fail to improve it to the utmoſt: he had already acquired much by his publications, and he was all attention to acquire more. In 1717, he publiſhed a collection of all he had printed ſeparately; and proceeded to give a new edition of Shakeſpeare; which, being publiſhed in 1721, diſcovered that he had conſulted his fortune more than his fame in that undertaking. The Iliad being finiſhed, he engaged upon the like footing to undertake the Odyſſey. Mr Broome and Mr Fenton did part of it, and received 500l. of Mr Pope for their labours. It was publiſhed in the ſame manner, and on the ſame conditions to Lintot; excepting that, inſtead of 1200 l. he had but 600l. for the copy. This work being finiſhed in 1725, he was afterwards employed with Swift and Arbuthnot in printing ſome volumes of Miſcellanies. About this time he narrowly eſcaped loſing his life, as he was returning home in a friend's chariot; which, on paſſing a bridge, happened to be overturned, and thrown with the horſes into the river.

The glaſſes were up, and he was not able to break them: ſo that he had immediately been drowned, if the poſtillion had not broke them, and dragged him out to the bank. A fragment of the glaſs, however, cut him ſo deſperately, that he ever after loſt the uſe of two of his fingers. In 1727 his Dunciad appeared in Ireland; and the year after in England, with notes by Swift, under the name of *Scriblerus*. This edition was preſented to the king and queen by Sir Robert Walpole; who, probably about this time, offered to procure Pope a penſion, which however he refuſed, as he had formerly done a propoſal of the ſame kind made him by Lord Halifax. He greatly cultivated the ſpirit of independency; and "Unplac'd, unpenſion'd, no man's heir or ſlave," was frequently his boaſt. He ſomewhere obſerves, that the life of an author is a ſtate of warfare: he has ſhown himſelf a complete general in this way of warring. He bore the inſults and injuries of his enemies long; but at length, in the Dunciad, made an abſolutely univerſal ſlaughter of them: for even Cibber, who afterwards advanced to be the hero of it, could not forbear owning, that nothing was ever more perfect and finiſhed in its kind than this poem. In 1729, by the advice of Lord Bolingbroke, he turned his pen to ſubjects of morality; and accordingly we find him, with the aſſiſtance of that noble friend, who furniſhed him with the materials, at work this year upon the Eſſay on Man. The following extract of a letter to Swift diſcovers the reaſon of his Lordſhip's advice: "Bid him (ſays Bolingbroke) talk to you of the work he is about, I hope in good earneſt; it is a fine one, and will be, in his hands, an original. His ſole complaint is, that he finds it too eaſy in the execution. This flatters his lazineſs: it flatters my judgement; who always thought, that, univerſal as his talents are, this is eminently and peculiarly his, above all the writers I know, living or dead; I do not except Horace." Pope tells the dean in the next letter, that "the work Lord Bolingbroke ſpeaks of with ſuch abundant partiality, is a ſyſtem of ethics, in the Horatian way." In purſuing the ſame deſign, he wrote his Ethic Epiſtles: the fourth of which, upon Taſte, giving great offence, as he was ſuppoſed to ridicule the duke of Chandos under the character of Timon, is ſaid to have put him upon writing ſatires, which he continued till 1739. He ventured to attack perſons of the higheſt rank, and ſet no bounds to his ſatirical rage. A genuine collection of his letters was publiſhed in 1737. In 1738, a French tranſlation of the Eſſay on Man, by the Abbé Reſnel, was printed at Paris; and Mr Crouſaz, a German profeſſor, animadverted upon this ſyſtem of ethics, which he repreſented as nothing elſe but a ſyſtem of naturaliſm. Mr Warburton, afterwards biſhop of Glouceſter, wrote a commentary upon the Eſſay; in which he defends it againſt Crouſaz, whoſe objections he ſuppoſes owing to the faultineſs of the Abbé Reſnel's tranſlation. The poem was republiſhed in 1740, with the commentary. Our author now added a fourth book to the Dnnciad, which was firſt printed ſeparately in 1742: but the year after, the whole poem came out together, as a ſpecimen of a more correct edition of his works. He had made ſome progreſs in that deſign, but did not live to complete it. He had all his life long been ſubject to the head ach; and that complaint, which he derived from his mother, was now greatly increaſed by a dropſy in his breaſt, under which he expired the 30th of May 1744, in the 56th year of his age. In his will, dated December 12. 1743, Miſs Blount, a lady to whom he was always devoted, was made his heir during her life; and among other legacies, he bequeathed to Mr Warburton the property of all ſuch of his works, already printed, as he had written, or ſhould write commentaries upon, and which had not otherwiſe been diſpoſed of or alienated; with this condition, that they were publiſhed without future alterations. In diſcharge of this truſt, that gentleman gave a complete edition of all Mr Pope's works, 1751, in 9 vols, 8vo. A work, entitled, *An Eſſay on the Writings and Genius of Pope*, by Mr Warton, 2 vols 8vo, will be read with pleaſure by thoſe who deſire to know more of the perſon, character, and writings of this excellent poet. Lord Orrery's account of him is very flattering: "If we may judge of him by his works (ſays this noble author), his chief aim was to be eſteemed a man of virtue. His letters are written in that ſtyle; his laſt volumes are all of the moral kind; he has avoided trifles, and conſequently has eſcaped a rock which has proved very injurious to Swift's reputation. He has given his imagination full ſcope, and yet has preſerved a perpetual guard upon his conduct. The conſtitution of his body and mind might really incline him to the habits of caution and reſerve. The treatment which he met with afterwards, from an innumerable tribe of adverſaries, confirmed this habit; and made him ſlower than the dean in pronouncing his judgment upon perſons and things. His proſe-writings are little leſs harmonious than his verſe; and his voice, in common converſation was ſo naturally muſical, that I remember honeſt Tom Southern uſed to call him the *little nightingale*. His manners were delicate, eaſy, and engaging; and he treated his friends with a politeneſs that charmed, and a generoſity that was much to his honour. Every gueſt was made happy within his doors; pleaſure dwelt under his roof, and elegance preſided at his table."

Yet, from Dr Johnſon's account of his domeſtic habits, we have reaſon to doubt the latter part of this character. His parſimony (he informs us) appeared in very petty matters, ſuch as writing his compoſitions on the backs of letters, or in a niggardly reception of his friends, and a ſcantineſs of entertainment—as the ſetting a ſingle pint on the table to two friends, when, having himſelf taken two ſmall glaſſes, he would retire, ſaying, I leave you to your wine. He ſometimes, however, the Doctor acknowledges, made a ſplendid dinner; but this happened ſeldom. He was very full of his fortune, and frequently ridiculed poverty; and he ſeems to have been of an opinion not very uncommon in the world, that to want money is to want every thing. He was almoſt equally proud of his connection with the great, and often boaſted that he obtained their notice by no meanneſs or ſervility. This admiration of the great increaſed in the advance of life; yet we muſt acknowledge, that he could derive but little honour from the notice of Cobham, Burlington, or Bolingbroke.

By natural deformity, or accidental diſtortion, his vital functions were ſo much diſordered, that his life was a long diſeaſe; and from this cauſe aroſe many of his peculiarities and weakneſſes. He ſtood conſtantly

Pope.

in need of female attendance; and to avoid cold, of which he was very ſenſible, he wore a fur doublet under his ſhirt, &c. The indulgence and accommodation which his ſickneſs required, had taught him all the unpleaſing and unſocial qualities of a valetudinary man.—When he wanted to ſleep, he nodded in company; and once ſlumbered at his own table when the prince of Wales was talking of poetry. He was extremely troubleſome to ſuch of his friends as aſked him out, which many of them frequently did, and plagued the ſervants beyond deſcription. His love of eating is another fault to which he is ſaid to have fallen a ſacrifice. In all his intercourſe with mankind, he had great delight in artifice, and endeavoured to attain all his purpoſes by indirect and unſuſpected methods.

In familiar converſation it is ſaid he never excelled; and he was ſo fretful and ſo eaſily diſpleaſed, that he would ſometimes leave Lord Oxford's ſilently without any apparent reaſon, and was to be courted back by more letters and meſſages than the ſervants were willing to carry.

Dr Johnſon alſo gives a view of the intellectual character of Pope, and draws a parallel between Dryden and him. For particulars, however, we muſt refer our readers to *Johnſon's Lives of the Poets*.

Pope's Dominions, or *Eccleſiaſtical States*, a country of Italy, bounded on the north by the gulph of Venice and the Venetian dominions, on the ſouth by the Mediterranean, on the eaſt by the kingdom of Naples and the Adriatic, and on the weſt by Tuſcany and Modena. It is 400 miles long on the coaſt of the Adriatic from Naples to the Venetian territory. It is but narrow, however, from north to ſouth, not being more than 80 miles broad from the gulph of Venice to the Tuſcan ſea.

The ſoil, in general, of the pope's dominions is very fertile, but ill cultivated; and there are many fens and marſhy grounds which are very prejudicial to the air. That the lands are badly cultivated and inhabited, the air bad, and the inhabitants poor, idle, lazy, and groſsly ſuperſtitious, is owing to a variety of cauſes. With reſpect to the accommodations of life, this country is but in a very indifferent condition; for, notwithſtanding the fertility of its ſoil, its advantageous ſituation for traffic, the large ſums ſpent in it by travellers, or remitted to it from foreign countries, and its having, for its ruler, the ſucceſſor of St Peter, the prince of the apoſtles, and the vicar of Jeſus Chriſt; yet it is poor and thin of inhabitants, ill cultivated, and without trade and manufactures. This is partly owing to the great number of holidays, of ſturdy beggars called *pilgrims*, and of hoſpitals and convents, with the amazing but perhaps uſeleſs wealth of churches and convents, and the inquiſition: but the chief cauſe is the ſeverity of the government, and the grievious exactions and hardſhips to which the ſubjects are expoſed. The legates, though moſtly clergymen, whoſe thoughts ſhould be chiefly employed about laying up treaſures in heaven, and who ought to ſet an example to the laity of diſintereſtedneſs and a contempt of this world, too often, it is ſaid, ſcruple no kind of rapaciouſneſs: even the holy father himſelf, and the cardinals, frequently make the enriching of their nephews and other relations, and the aggrandizing their families, too much the buſineſs of their lives. The extenſive claims and great pretenſions of the pope are well known, and by a large part of Chriſtendom, are now treated with contempt and mockery. The Reformation gave a great blow to his ſpiritual power; and the French revolution has leſſened it ſtill more. His temporal dominions, however, ſtill continue much the ſame; though how long this may be the caſe, conſidering how much he hath loſt, and is daily loſing, of his ghoſtly empire, and the veneration in which he was formerly held, it is difficult to ſay. See Pope, p. 378. col. 1.—The Campania of Rome is under the pope's immediate government; but the other provinces are governed by legates and vice-legates, and there is a commander in chief of the pope's forces in every province. The pope is choſen by the cardinals in the conclave: See this particularly deſcribed under Pope. The pope holds a conſiſtory of cardinals on eccleſiaſtical affairs; but the cardinals do not meddle with his civil government. The pope's chief miniſter is the cardinal-patron, uſually his nephew, who amaſſes an immenſe eſtate, if the reign be of any long duration. The cardinal that is choſen pope muſt generally be an Italian, and at leaſt 55 years of age. The ſpiritual power of the pope, though far ſhort of what it was before the Reformation, is ſtill conſiderable. It is computed that the monks and regular clergy, who are abſolutely at his devotion, do not amount to leſs than 2,000,000 of people, diſperſed through all the Roman Catholic countries, to aſſert his ſupremacy over princes, and promote the intereſt of the church. The revenues of theſe monks do not fall ſhort of L. 20,000,000 Sterling, beſides the caſual profits ariſing from offerings, and the people's bounty to the church, who are taught that their ſalvation depends on this kind of benevolence.

Pope, Popery.

The pope's revenues, as a temporal prince, may amount to about L. 1,000,000 Sterling *per aunum*, ariſing chiefly from the monopoly of corn, the duties on wine and other proviſions. Over and above theſe, vaſt ſums are continually flowing into the papal treaſury from all the Roman Catholic countries, for diſpenſations, indulgences, canonizations, annates, the pallia, and inveſtitures of archbiſhops, biſhops, &c.

The pope has a conſiderable body of regular forces, well clothed and paid; but his fleet conſiſts only of a few galleys. His life-guards are 40 Switzers, 75 cuiraſſiers, and as many light horſe. Since the beginning of this war, we are told, he has likewiſe had a guard of Engliſh horſe.

POPERY, in eccleſiaſtical hiſtory, comprehends the religious doctrines and practices adopted and maintained by the church of Rome. The following ſummary, extracted chiefly from the decrees of the council of Trent, continued under Paul III. Julius III. and Pius IV. from the year 1545 to 1563, by ſucceſſive ſeſſions, and the creed of pope Pius IV. ſubjoined to it, and bearing date November 1564, may not be unacceptable to the reader. One of the fundamental tenets, ſtrenuouſly maintained by popiſh writers, is the infallibility of the church of Rome; though they are not agreed whether this privilege belongs to the pope or a general council, or to both united; but they pretend that an infallible living judge is abſolutely neceſſary to determine controverſies, and to ſecure peace in the Chriſtian church. However, Proteſtants allege, that the claim of infallibility in any church is not juſtified by the authority of Scripture; much leſs does it pertain to the church of Rome; and that it is inconſiſtent with the nature of religion, and the perſonal obligations of its profeſſors; and that it has proved ineffectual to the end for which it is ſuppoſed to be granted, ſince popes and councils have diſagreed in matters of importance, and they have been incapable, with the advantage of this pretended infallibility, of maintaining union and peace.

Another eſſential article of the popiſh creed is the ſupremacy of the pope, or his ſovereign power over the univerſal church. See Pope.

Farther, the doctrine of the ſeven ſacraments is a peculiar and diſtinguiſhing doctrine of the church of Rome: theſe are baptiſm, confirmation, the euchariſt, penance, extreme unction, orders, and matrimony.

The council of Trent (ſeſſ. 7. can. 1.) pronounces an anathema on thoſe who ſay, that the ſacraments are more or fewer than ſeven, or that any one of the above number is not truly and properly a ſacrament. And yet it does not appear that they amounted to this number before the 12th century, when Hugo de St Victore and Peter Lombard, about the year 1144, taught that there were ſeven ſacraments. The council of Florence, held in 1438, was the firſt council that determined this number. Theſe ſacraments confer grace, according to the decree of the council of Trent (ſeſ. 7. can. 8.) *ex opere operato*, by the mere adminiſtration of them: three of them, viz. baptiſm, confirmation, and orders, are ſaid (can. 9.) to impreſs an indelible character, ſo that they cannot be repeated without ſacrilege; and the efficacy of every ſacrament depends on the intention of the prieſt by whom it is adminiſtered (can. 11.) Pope Pius expreſsly enjoins, that all theſe ſacraments ſhould be adminiſtered according to the received and approved rites of the Catholic church. With regard to the euchariſt in particular, we may here obſerve, that the church of Rome holds the doctrine of tranſubſtantiation; the neceſſity of paying divine worſhip to Chriſt under the form of the conſecrated bread, or hoſt; the propitiatory ſacrifice of the maſs, according to their ideas of which Chriſt is truly and properly offered as a ſacrifice as often as the prieſt ſays maſs; it practiſes likewiſe ſolitary maſs, in which the prieſt alone, who conſecrates, communicates, and allows communion only in one kind, viz. the bread, to the laity. Seſſ. 14.

The doctrine of merits is another diſtinguiſhing tenet of popery; with regard to which the council of Trent has expreſsly decreed (ſeſſ. 6. can. 32.) that the good works of juſtified perſons are truly meritorious; deſerving not only an increaſe of grace, but eternal life, and an increaſe of glory; and it has anathematized all who deny this doctrine. Of the ſame kind is the doctrine of ſatisfactions; which ſuppoſes that penitents may truly ſatisfy, by the afflictions they endure under the diſpenſations of Providence, or by voluntary penances to which they ſubmit, for the temporal penalties of ſin, to which they are ſubject, even after the remiſſion of their eternal puniſhment. Seſſ. 6. can 30. and ſeſſ. 14. can. 8. and 9. In this connection we may mention the popiſh diſtinction of venial and mortal ſins: the greateſt evils ariſing from the former are the temporary pains of purgatory; but no man, it is ſaid, can obtain the pardon of the latter without confeſſing to a prieſt, and performing the penances which he impoſes.

The council of Trent (ſeſſ. 14. can. 1.) has expreſsly decreed, that every one is accurſed, who ſhall affirm that penance is not truly and properly a ſacrament, inſtituted by Chriſt in the univerſal church, for reconciling thoſe Chriſtians to the divine majeſty, who have fallen into ſin after baptiſm: and this ſacrament, it is declared, conſiſts of two parts, the matter and the form; the matter is the act of the penitent, including contrition, confeſſion, and ſatisfaction; the form of it is the act of abſolution on the part of the prieſt. Accordingly it is enjoined, that it is the duty of every man, who hath fallen after baptiſm, to confeſs his ſins once a year, at leaſt, to a prieſt: that this confeſſion is to be ſecret; for public confeſſion is neither commanded nor expedient: and that it muſt be exact and particular, including every kind and act of ſin, with all the circumſtances attending it. When the penitent has ſo done, the prieſt pronounces an abſolution; which is not conditional or declarative only, but abſolute and judicial. This ſecret, or auricular confeſſion, was firſt decreed and eſtabliſhed in the fourth council of Lateran, under Innocent III. in 1215, (cap. 21.) And the decree of this council was afterwards confirmed and enlarged in the council of Florence, and in that of Trent; which ordains, that confeſſion was inſtituted by Chriſt, that by the law of God it is neceſſary to ſalvation, and that it has been always practiſed in the Chriſtian church. As for the penances impoſed on the penitent by way of ſatisfaction, they have been commonly the repetition of certain forms of devotion, as pater-noſters, or ave-marias, the payment of ſtipulated ſums, pilgrimages, faſts, or various ſpecies of corporal diſcipline. But the moſt formidable penance, in the eſtimation of many who have belonged to the Romiſh communion, has been the temporary pains of purgatory. But under all the penalties which are inflicted or threatened in the Romiſh church, it has provided relief by its indulgences, and by its prayers or maſſes for the dead, performed profeſſedly for relieving and reſcuing the ſouls that are detained in purgatory.

Another article that has been long authoritatively enjoined and obſerved in the church of Rome, is the celibacy of her clergy. This was firſt enjoined at Rome by Gregory VII. about the year 1074, and eſtabliſhed in England by Anſelm archbiſhop of Canterbury about the year 1175; though his predeceſſor Lanfranc had impoſed it upon the prebendaries and clergy that lived in towns. And though the council of Trent was repeatedly petitioned by ſeveral princes and ſtates to aboliſh this reſtraint, the obligation of celibacy was rather eſtabliſhed than relaxed by this council; for they decreed, that marriage contracted after a vow of continence, is neither lawful nor valid; and thus deprived the church of the poſſibility of ever reſtoring marriage to the clergy. For if marriage, after a vow, be in itſelf unlawful, the greateſt authority upon earth cannot diſpenſe with it, nor permit marriage to the clergy, who have already vowed continence.

To the doctrines and practices above recited may be farther added the worſhip of images, of which Proteſtants accuſe the Papiſts. But to this accuſation the Papiſt replies, that he keeps images by him to preſerve

Papiſt Miſrepreſented and Repreſented.

in his mind the memory of the perſons repreſented by them; as people are wont to preſerve the memory of their deceaſed friends by keeping their pictures. He is taught (he ſays) to uſe them ſo as to caſt his eyes upon the pictures or images, and thence to raiſe his heart to the things repreſented, and there to employ it in meditation, love, and thankſgiving, deſire of imitation, &c. as the object requires.

Theſe pictures or images have this advantage, that they inform the mind by one glance of what in reading might require a whole chapter. There being no other difference between them, than that reading repreſents leiſurely and by degrees; and a picture, all at once. Hence he finds a convenience in ſaying his prayers with ſome devout pictures before him, he being no ſooner diſtracted, but the ſight of theſe recals his wandering thoughts to the right object; and as certainly brings ſomething good into his mind, as an immodeſt picture diſturbs his heart with filthy thoughts. And becauſe he is ſenſible that theſe holy pictures and images repreſent and bring to his mind ſuch objects as in his heart he loves, honours, and venerates; he cannot but upon that account love, honour, and reſpect, the images themſelves.

Ibid.

The council of Trent likewiſe decreed, that all biſhops and paſtors who have the cure of ſouls, do diligently inſtruct their flocks, *that it is good and profitable to deſire the interceſſion of ſaints reigning with Chriſt in heaven*. And this decree the Papiſts endeavour to defend by the following obſervations. They confeſs that we have but one Mediator of redemption; but affirm that it is acceptable to God that we ſhould have many mediators of interceſſion. Moſes (ſay they) was ſuch a mediator for the Iſraelites; Job for his three friends; Stephen for his perſecutors. The Romans were thus deſired by St Paul to be his mediators; ſo were the Corinthians, ſo the Epheſians, *Ep. ad* Rom. Cor. Eph. ſo almoſt every ſick man deſires the congregation to be his mediators, by remembering him in their prayers. And ſo the Papiſt deſires the bleſſed in heaven to be his mediators; that is, that they would pray to God for him. But between theſe living and dead mediators there is no ſimilarity: the living mediator is preſent, and certainly hears the requeſt of thoſe who deſire him to intercede for them; the dead mediator is as certainly abſent, and cannot poſſibly hear the requeſts of all thoſe who at the ſame inſtant may be begging him to intercede for them, unleſs he be poſſeſſed of the divine attribute of omnipreſence; and he who gives that attribute to any creature is unqueſtionably guilty of idolatry. And as this decree is contrary to one of the firſt principles of natural religion, ſo does it receive no countenance from Scripture, or any Chriſtian writer of the three firſt centuries. Other practices peculiar to the Papiſts are the religious honour and reſpect that they pay to ſacred relicks; by which they underſtand not only the bodies and parts of the bodies of the ſaints, but any of thoſe things that appertained to them, and which they touched; and the celebration of divine ſervice in an unknown tongue: to which purpoſe the council of Trent hath denounced an anathema on any one who ſhall ſay that maſs ought to be celebrated only in the vulgar tongue; ſeſſ. 25. and ſeſſ. 22. can. 9. Though the council of Lateran under Innocent III. in 1215 (can. 9.) had expreſsly decreed, that becauſe in many parts within the ſame city and dioceſe there are many people of different manners and rites mixed together, but of one faith, the biſhops of ſuch cities or dioceſes ſhould provide fit men for celebrating divine offices, according to the diverſity of tongues and rites, and for adminiſtering the ſacraments.

We ſhall only add, that the church of Rome maintains, that unwritten traditions ought to be added to the holy Scriptures, in order to ſupply their defect, and to be regarded as of equal authority; that the books of the Apocrypha are canonical ſcripture; that the vulgate edition of the Bible is to be deemed authentic; and that the Scriptures are to be received and interpreted according to that ſenſe which the holy mother church, to whom it belongs to judge of the true ſenſe, hath held, and doth hold, and according to the unanimous conſent of the fathers.

Such are the principal and diſtinguiſhing doctrines of Popery, moſt of which have received the ſanction of the council of Trent, and that of the creed of pope Pius IV. which is received, profeſſed, and ſworn to by every one who enters into holy orders in the church of Rome; and at the cloſe of this creed, we are told that the faith contained in it is ſo abſolutely and indiſpenſably neceſſary, that no man can be ſaved without it.

Many of the doctrines of Popery were relaxed, and very favourably interpreted by M. de Meaux, biſhop of Condom, in his Expoſition of the Doctrine of the Catholic Church, firſt printed in the year 1671: but this edition, which was charged with perverting, in endeavouring to palliate, the doctrine of the church, was cenſured by the doctors of the Sorbonne, and actually ſuppreſſed; nor does it appear that they ever teſtified their approbation in the uſual form of ſubſequent and altered editions. It has, however, been lately publiſhed in England; by a clergyman of the Romiſh church, whoſe integrity, piety, and benevolence, would do honour to any communion.

POPHAM (Sir John), lord chief juſtice of the common pleas in the reign of Queen Elizabeth, was the eldeſt ſon of Edward Popham, Eſq; of Huntworth in Somerſetſhire, and born in the year 1531. He was ſome time a ſtudent of Baliol college in Oxford; "being then (ſays Ant. Wood) given at leiſure hours to many ſports and exerciſes." After quitting the univerſity, he fixed in the Middle Temple; where, during his noviciate, he is ſaid to have indulged in that kind of diſſipation to which youth and a vigorous conſtitution more naturally incline than to the ſtudy of voluminous *reports*: but, ſatiated at length with what are called the *pleaſures of the town*, he applied ſeduloufly to the ſtudy of his profeſſion, was called to the bar, and in 1568 became ſummer or autumn reader. He was ſoon after made ſerjeant at law, and ſolicitor-general in 1579. In 1581, he was appointed attorney-general, and treaſurer of the Middle temple. In 1592, he was made lord chief juſtice of the king's bench, and the ſame year received the honour of knighthood. In the year 1601, his lordſhip was one of the council detained by the unfortunate earl of Eſſex, when he formed the ridiculous project of defending himſelf in his houſe: and, on the earl's trial, he gave evidence againſt him relative to their detention. He died in the year 1607, aged 76; and was buried in the ſouth aiſle of the church at Wellington in Somerſetſhire, where he generally reſided as often as it was in his power to retire. He was thought ſomewhat ſevere in the execution of the law againſt capital offenders: but his ſeverity had the happy effect of reducing the number of highway robbers. He wrote, 1. Reports and caſes adjudged in the time of Queen Elizabeth. 2. Reſolutions and judgments upon caſes and matters agitated in all the courts at Weſtminſter in the latter end of Queen Elizabeth's reign.

POPLAR, in botany. See Populus.

POPLITÆUS, in anatomy, a ſmall muſcle obliquely pyramidal, ſituated under the ham. See Anatomy, *Table of the Muſcles*.

POPPY, in botany. See Opium and Papaver.

POPULAR, ſomething that relates to the common people.

POPULATION, means the ſtate of a country with reſpect to the number of people. See *Bills of Mortality* and *Political-Arithmetic*.

The queſtion concerning the number of men exiſting upon earth, has been variouſly determined by different writers. Riccioli ſtates the population of the globe at 1000 millions, Voſſius at 500; the Journaliſts of Trevoux at 720; and the editor (Xavier de Feller) of the ſmall Geographical Dictionary of Voſgien, reprinted at Paris in 1778, at 370 millions. This laſt eſtimate is perhaps too low, although the writer profeſſes to have taken conſiderable pains to aſcertain the point with as much accuracy as the nature of the ſubject will admit. It may, perhaps, not be deemed unworthy the attention of the curious ſpeculatiſt to obſerve, that aſſuming the more probable ſtatement of the learned Jeſuits of Trevoux, and that the world has exiſted about 6006 years in its preſent ſtate of population, then the whole number of perſons who have ever exiſted upon earth ſince the days of Adam amounts only to about one hundred and thirty thouſand millions; becauſe 720,000,000 × 182 (the number of generations in 6006 years) = 131,040,000,000. See on this ſubject the authors abovementioned, as likewiſe Beauſobre's *Etude de la Politique*.

With regard to the population of England, the reader may conſult, together with our article *Political-Arithmetic*, An inquiry into the preſent State of Population, &c. by W. Wales, F. R. S. and Mr Howlett's Examination of Dr Price's Eſſay, on the ſame ſubject.

POPULUS, the Poplar: A genus of the octandria order, belonging to the diœcia claſs of plants; and in the natural method ranking under the 50th order, *Amentaceæ*. The calyx of the amentum is a lacerated, oblong, and ſquamous leaf; the corolla is turbinated, oblique, and entire. The female has the calyx of the amentum and corolla the ſame as in the male; the ſtigma is quadrifid; the capſule bilocular, with many pappous ſeeds.

The poplar, one of the moſt beautiful of the aquatic trees, has frequently been introduced into the poetical deſcriptions of the ancients; as by Virgil, *Ecl.* vii. 66. ix. 41. *Georg.* ii. 66. iv. 511. *Æn.* viii. 31. 276. by Ovid, *Amom. Parid.* 27. by Horace, *Carm.* ii. 3. and by Catulus, *Nupt. Pil. et Thet.* 290. &c. &c.

Species. 1. The alba, or abele-tree, grows naturally in the temperate parts of Europe. Its leaves are large, and divided into three, four, or five lobes, indented on their edges, of a very dark colour on their upper ſide, but very white and downy on the under ſide; ſtanding upon footſtalks an inch long. The young branches have a purple bark, and are covered with a white down; but the bark of the ſtem and older branches is grey. In the beginning of April, the male flowers or catkins appear, which are cylindrical, and about three inches long. About a week after come out the female flowers or catkins, which have no ſtamina like thoſe of the male. Soon after theſe come out, the male catkins fall off; and in five or ſix weeks after the female flowers will have ripe ſeeds incloſed in a hairy covering. The catkins will then drop, and the ſeeds be wafted by the winds to a great diſtance. 2. The major, or white poplar, has its leaves rounder than the firſt, and not much above half their ſize: they are indented on their edges, and are downy on their under ſide, but not ſo white as thoſe of the former, nor are their upper ſurfaces of ſuch a deep green colour. 3. The nigra, or black poplar, has oval heart-ſhaped leaves, ſlightly crenated on their edges; they are ſmooth on both ſides, and of a light green colour. 4. The tremula, or aſpen-tree, has roundiſh, angularly indented leaves: they are ſmooth on both ſides, and ſtand on long footſtalks, and ſo are ſhaken by the leaſt wind; from whence it has the title of the *trembling poplar*, or *aſpen-tree*. 5. The balſamifera, or Carolina poplar, is a native of Carolina, where it becomes a large tree. The ſhoots of this ſort grow very ſtrong in Britain, and are generally angular; with a light green bark like the willow. The leaves on young trees, and alſo thoſe on the lower ſhoots, are very large, almoſt heart-ſhaped, and crenated; but thoſe upon the older trees are ſmaller: as the trees advance, their bark becomes lighter, approaching to a greyiſh colour. 6. The tacamahaca, grows naturally in Canada and other parts of North America. This is a tree of a middling growth, ſending out on every ſide many ſhort thick ſhoots, which are covered with a light brown bark, garniſhed with leaves differing from one another in ſhape and ſize; moſt of them are almoſt heart-ſhaped; but ſome are oval, and others nearly ſpear-ſhaped; they are whitiſh on their under ſide, but green on their upper.

Culture. Theſe trees may be propagated either by layers or cuttings, as alſo from ſuckers which the white poplars ſend up from their roots in great plenty. The beſt time for tranſplanting theſe ſuckers is in October, when their leaves begin to decay. Theſe may be placed in a nurſery for two or three years, to get ſtrength before they are planted out where they are deſigned to remain; but if they are propagated from cuttings, it is better to defer the doing of that until February, at which time truncheons of two or three feet long ſhould be thruſt about a foot and a half into the ground.—Theſe will readily take root; and if the ſoil in which they are planted be moiſt, they will arrive at a conſiderable bulk in a few years. The black poplar is leſs apt to take root from large truncheons; therefore it is a better method to plant cuttings of it about a foot and a half in length, thruſting them a foot deep in the ground. This ſort will grow almoſt on any ſoil, but will thrive beſt in moiſt places. The Carolina poplar may alſo be propagated by cuttings or layers; but the laſt is the method generally practiſed, and the plants raiſed by it are leſs moiſt than others. The ſhoots of this tree, while young, are frequently killed down to a conſiderable length by the froſt in winter; but as the trees grow older, their ſhoots are not ſo vigorous, and become more ligneous, ſo are not liable to the ſame diſaſter. But the trees ſhould be planted in a ſheltered ſituation: for as their leaves are very large, the wind has great power over them; and the branches being tender, they are frequently broken or ſplit by the winds in ſummer, when they are much expoſed. The tacamahaca ſends up a great number of ſuckers from its roots, by which it multiplies in plenty; and every cutting which is planted will take root.

Uſes. The wood of theſe trees, eſpecially of the abele, is good for laying floors, where it will laſt for many years; and on account of its extreme whiteneſs is by many preferred to oak; yet, on account of its ſoft contexture, being very ſubject to take the impreſſion of nails, &c. it is leſs proper on this account than the harder woods. The abele likewiſe deſerves particular notice, on account of the virtue of its bark in curing intermitting fevers. The Reverend Mr Stone, in Phil. Tranſ. vol. LIII. p. 195. tells us, that he gathers the bark in ſummer when it is full of ſap, and having dried it by a gentle heat, gives a dram powdered every four hours betwixt the fits. In a few obſtinate caſes, he mixed one-fifth part of Peruvian bark with it. It is remarkable how nature has adapted remedies to diſeaſes. Intermitting fevers are moſt prevalent in wet countries; and this tree grows naturally in ſuch ſituations. The bark of it is an object well worthy the attention of phyſicians; and if its ſucceſs upon a more enlarged ſcale of practice prove equal to Mr Stone's experiments, the world will be much indebted to him for communicating them. This bark will alſo tan leather.

The inner bark of the black poplar is uſed by the inhabitants of Kamſchatka as a material for bread; and paper has ſometimes been made of the cottony down of the ſeeds. The roots have been obſerved to diſſolve into a kind of gelatinous ſubſtance, and to be coated over with a tubular cruſtaceous ſpar, called by naturaliſts *oſteocolla**, formerly imagined to have ſome virtue in producing the callus of a fractured bone. The buds of the ſixth ſpecies are covered with a glutinous reſin, which ſmells very ſtrong, and is the gum tacamahaca of the ſhops. The beſt, called, from its being collected in a kind of gourd ſhells, *tacamahaca in ſhells*, is ſomewhat unctuous and ſoftiſh, of a pale yellowiſh or greeniſh colour, an aromatic taſte, and a fragrant delightful ſmell, approaching to that of lavender or ambergriſe. This ſort is very rare; that commonly found in the ſhops is in ſemitranſparent globes or grains, of a whitiſh, yellowiſh, browniſh, or greeniſh colour, of a leſs grateful ſmell than the foregoing. This reſin is ſaid to be employed externally by the Indians for diſcuſſing and maturating tumours, and abating pains in the limbs. It is an ingredient in ſome anodyne, hyſteric, cephalic and ſtomachic plaſters; but the fragance of the finer ſort ſufficiently points out its utility in other reſpects.

* See Oſteocolla.

M. Fougeroux de Bondaroy, from a ſet of experiments on the ſubject, gives an account of the uſes of the ſeveral kinds of poplar, the ſubſtance of which is as follows: He finds that the wood of the black poplar is good and uſeful for many purpoſes; that the Lombardy poplar, *populus faſtigata*, is of very little value; that the Virginia poplar, *populus Virginiana*, affords a wood of excellent quality, that may be applied to many uſes. The Carolina poplar, *populus Carolinenſis—heterophilla*, (Linn.) is a very quick grower; beautiful when ſound, but liable to be hurt by cold. Its wood appeared to M. de Bondaroy to be of little value; but M. Maleſherbes, who cut down a large tree of this ſort, was aſſured by his carpenter that the wood was very good.—That the tacamahaca, *populus tacamahaca balſamifera*, is a dwarfiſh plant (A), of little value.—That the liard, *populus Canadenſis*, is a large tree, the wood light, not eaſy to be ſplit, and fit for ſeveral uſes.—That the white poplar, *populus alba*, is a large growing tree, affording a wood of excellent quality, and is among the moſt valuable of this ſpecies.—That the trembling poplar, *populus tremula*, (Linn.) is neither ſo large a tree nor affords ſuch wood as the former. Theſe are in few words the principal reſult of the experiments of this gentleman on this claſs of plants. A few other ſorts are mentioned, but nothing deciſive with regard to them is determined.

From ſome experiments made by M. Dambourney, it appears that the poplar may be uſefully employed in dyeing. The Italian poplar gives a dye of as fine a luſtre, and equally durable, as that of the fineſt yellow wood, and its colour is more eaſily extracted. It is likewiſe very apt to unite with other colours in compoſition. Beſides the *populus faſtigata*, M. Dambourney tried alſo the black poplar, the Virginian *ditto*, the balſam *ditto* or *liard*, the white *ditto*, and the trembling poplar; and found that all theſe dyed wool of a nut-colour, fawn-colour *(vigagne)*, Nankin, muſk, and other grave ſhades, according to the quantity of wood employed, and the length of time it was boiled.

POQUELIN or **POCQUELIN** (John Baptiſt.) See MOLIERE.

PORANA, in botany; a genus of the monogynia order, belonging to the pentandria claſs of plants. The corolla is campanulated; the calyx is quinquefid, and larger than the fruit; the ſtyle ſemibifid, long, and permanent; the ſtigmata globular; the perianthium bivalved.

1 What is called porcelain.

PORCELAIN, a fine kind of earthen ware, chiefly manufactured in China, and thence called *China-ware*. All earthen wares which are white and ſemitranſparent are generally called *porcelains*: but amongſt theſe, ſo great differences may be obſerved, that, notwithſtanding the ſimilarity of their external appearance, they cannot be conſidered as matters of the ſame kind. Theſe differences are ſo evident, that even perſons who are not connoiſſeurs in this way prefer much the porcelain of ſome countries to that of others.

2 Origin of the name.

The word *porcelain* is of European derivation; none of the ſyllables which compoſe it can even be pronounced or written by the Chineſe, whoſe language com-

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(A) We have ſeen it above 30 feet high.

prehends no ſuch ſounds. It is probable that we are indebted to the Portugueſe for it: the word *porcellana*, however, in their language, ſignifies properly a cup or diſh; and they themſelves diſtinguiſh all works of porcelain by the general name of *loca*. Porcelain is called in China *tſé-ki*.

3 Art of making it in greater perfection in the Eaſt than in Europe.

The art of making porcelain is one of thoſe in which Europe has been excelled by oriental nations. The firſt porcelain that was ſeen in Europe was brought from Japan and China. The whiteneſs, tranſparency, fineneſs, neatneſs, elegance, and even the magnificence of this pottery, which ſoon became the ornament of ſumptuous tables, did not fail to excite the admiration and induſtry of Europeans; and their attempts have ſucceeded ſo well, that in different parts of Europe earthen wares have been made ſo like the oriental, that they have acquired the name of *porcelain*. The firſt European porcelains were made in Saxony and in France; and afterwards in England, Germany, and Italy: but as all theſe were different from the Japaneſe, ſo each of them had its peculiar character.

4 Beſt Chineſe porcelain at King-te-tching.

The fineſt and beſt porcelain of China is made in a village called *King-te-tching*, in the province of Kiang-ſi. This celebrated village is a league and a half in length, and we are aſſured that it contains a million of inhabitants. The workmen of King-te-tching, invited by the attracting allurements of the European trade, have eſtabliſhed manufactories alſo in the provinces of Fo-kien and Canton; but this porcelain is not eſteemed.—The emperor Kang-hi was deſirous of having ſome made under his own inſpection at Pe-king. For this purpoſe he collected workmen, together with tools, and all materials neceſſary; furnaces were alſo erected, but the attempt miſcarried. The village of *King-te-tching* ſtill continues the moſt celebrated place in the empire for beautiful porcelain, which is tranſported to all parts of the world, and even to Japan.

5 Origin of the art.

We are unable to diſcover who firſt found out the art of making porcelain, nor is it known whether the Chineſe were indebted to chance for it, or to the repeated efforts of inventive genius; we cannot even determine its antiquity with preciſion; we know only from the annals of Feou-leang, a city in the diſtrict to which King-te-tching belongs, that, ſince the year 442 of our era, the workmen of this village have always furniſhed the emperors with porcelain; and that one or two mandarins were ſent from court to inſpect their labours. It is, however, ſuppoſed that the invention of porcelain is much older than that epocha.

6 F. d'Entrecolles firſt gave an account of Chineſe porcelain.

7 Nature of the materials, and mode of preparing the paſte.

We are indebted to Father d'Entrecolles, a Romiſh miſſionary, for a very accurate account of the manner in which porcelain is made in China; and as he lived in King-te-tching, his information muſt have been the very beſt poſſible. We ſhall therefore give his account of the Chineſe manner of making it, as abridged by Groſier in his *General Deſcription of China*. The principal ingredients of the fine porcelain are *pe-tun-tſe* and *kao-lin*, two kinds of earth from the mixture of which the paſte is produced. The *kao-lin* is intermixed with ſmall ſhining particles; the other is purely white, and very fine to the touch. Theſe firſt materials are carried to the manufactories in the ſhape of bricks. The pe-tun-tſe, which is ſo fine, is nothing elſe but fragments of rock taken from certain quarries, and reduced to powder. Every kind of ſtone is not fit for this purpoſe. The colour of that which is good, ſay the Chineſe, ought to incline a little towards green. A large iron club is uſed for breaking theſe pieces of rock: they are afterwards put into mortars; and, by means of levers headed with ſtone bound round with iron, they are reduced to a very fine powder. Theſe levers are put in action either by the labour of men, or by water, in the ſame manner as the hammers of our paper-mills. The duſt afterwards collected is thrown into a large veſſel full of water, which is ſtrongly ſtirred with an iron ſhovel. When it has been left to ſettle for ſome time, a kind of cream riſes on the top, about four inches in thickneſs, which is ſkimmed off, and poured into another veſſel filled with water: the water in the firſt veſſel is ſtirred ſeveral times; and the cream which ariſes is ſtill collected, until nothing remains but the coarſe dregs, which, by their own weight, precipitate to the bottom: theſe dregs are carefully collected, and pounded anew.

With regard to what is taken from the firſt veſſel, it is ſuffered to remain in the ſecond until it is formed into a kind of cruſt at the bottom. When the water above it ſeems quite clear, it is poured off by gently inclining the veſſel, that the ſediment may not be diſturbed; and the paſte is thrown into large moulds proper for drying it. Before it is entirely hard, it is divided into ſmall ſquare cakes, which are ſold by the hundred. The colour of this paſte, and its form, have occaſioned it to receive the name of *pe-tun-tſe*.

The koa-lin, which is uſed in the compoſition of porcelain, requires leſs labour than the pe-tun-tſe. Nature has a greater ſhare in the preparation of it. There are large mines of it in the boſoms of certain mountains, the exterior ſtrata of which conſiſt of a kind of red earth. Theſe mines are very deep, and the kao-lin is found in ſmall lumps, that are formed into bricks after having gone through the ſame proceſs as the pe-tun-tſe. Father d'Entrecolles thinks, that the earth called *terre de Malte*, or St Paul's earth, has much affinity to the kao-lin, although thoſe ſmall ſhining particles are not obſerved in it which are interſperſed in the latter.

It is from the kao-lin that fine porcelain derives all its ſtrength; if we may be allowed the expreſſion, it ſtands it inſtead of nerves. It is very extraordinary, that a ſoft earth ſhould give ſtrength and conſiſtency to the pe-tun-tſe, which is procured from the hardeſt rocks. A rich Chineſe merchant told F. d'Entrecolles, that the Engliſh and Dutch had purchaſed ſome of the pe-tun-tſe, which they tranſported to Europe with a deſign of making porcelain; but having carried with them none of the kao-lin, their attempt proved abortive, as they have ſince acknowledged. "They wanted (ſaid this Chineſe, laughing) to form a body, the fleſh of which would ſupport itſelf without bones."

8 A new ſubſtance diſcovered and uſed by the Chineſe.

The Chineſe have diſcovered, within theſe few years, a new ſubſtance proper to be employed in the compoſition of porcelain. It is a ſtone, or rather ſpecies of chalk, called *hoa-che*, from which the phyſicians prepare a kind of draught that is ſaid to be deterſive, aperient, and cooling. The manufacturers of porcelain have thought proper to employ this ſtone inſtead of kao-lin. It is called hoa, becauſe it is glutinous, and has a great reſemblance to ſoap. Porcelain made with hoa-che is very rare, and much dearer than any other. It has an exceeding fine grain, and, with regard to the painting, if it be compared with that of the common porcelain, it appears to ſurpaſs it as much as vellum does paper. This porcelain is, beſides, ſo light, that it ſurpriſes thoſe who are accuſtomed to handle other kinds; it is alſo much more brittle; and it is very difficult to hit upon the proper degree of tempering it.

Hoa-che is ſeldom uſed in forming the body of the work; the artiſt is contented ſometimes with making it into a very fine ſize, in which the veſſel is plunged when dry, in order that it may receive a coat before it is painted and varniſhed: by theſe means it acquires a ſuperior degree of beauty.

When hoa-che is taken from the mine, it is waſhed in rain or river water, to ſeparate it from a kind of yellow earth which adheres to it. It is then pounded, put into a tub filled with water to diſſolve it, and afterwards formed into cakes like kao-lin. We are aſſured that hoa-che, when prepared in this manner, without the mixture of any other earth, is alone ſufficient to make porcelain. It ſerves inſtead of kao-lin; but it is much dearer. Kao-lin coſts only ten-pence Sterling; the price of hoa-che is half-a-crown: this difference, therefore, greatly enhances the value of porcelain made with the latter.

9
The ſplendor and whiteneſs of their porcelain derived from oil or varniſh.

To pe-tun-tſe and kao-lin, the two principal elements, muſt be added the oil or varniſh from which it derives its ſplendor and whiteneſs. This oil is of a whitiſh colour, and is extracted from the ſame kind of ſtone which produces the pe-tun-tſe, but the whiteſt is always choſen, and that which has the greeneſt ſpots. The oil is obtained from it by the ſame proceſs uſed in making the pe-tun-tſe: the ſtone is firſt waſhed and pulverized; it is then thrown into water, and after it has been purified it throws up a kind of cream. To 100 pounds of this cream is added one pound of che-kao, a mineral ſomething like alum, which is put into the fire till it becomes red-hot and then pounded. This mineral is a kind of runnet, and gives a conſiſtence to the oil, which is however carefully preſerved in its ſtate of fluidity. The oil thus prepared is never employed alone, another oil muſt be mixed with it, which is extracted from lime and fern aſhes, to 100 pounds of which is alſo added a pound of che-kao. When theſe two oils are mixed, they muſt be equally thick; and in order to aſcertain this, the workmen dip into each of them ſome cakes of the pe-tun-tſe, and by inſpecting their ſurfaces cloſely after they are drawn out, thence judge of the thickneſs of the liquors. With regard to the quantity neceſſary to be employed, it is uſual to mix 10 meaſures of ſtone-oil with one meaſure of the oil made from lime and fern aſhes.

10
Their mode of mixing the ſubſtances.

The firſt labour conſiſts in again purifying the pe-tun-tſe and the kao-lin. The workmen then proceed to mix theſe two ſubſtances together. For fine porcelain they put an equal quantity of the kao-lin and the pe-tun-tſe; for the middling ſort they uſe four parts of the kao-lin and ſix of the pe-tun-tſe. The leaſt quantity put of the former is one part to three of the pe-tun-tſe. When this mixture is finiſhed, the maſs is thrown into a large pit, well paved and cemented in every part; it is then trod upon, and kneaded until it becomes hard. This labour is ſo much the more fatiguing, as it muſt be continued without intermiſſion: were it interrupted, all the other labourers would remain unemployed. From this maſs, thus prepared, the workmen detach different pieces, which they ſpread out upon large ſlates, where they knead and roll them in every direction, carefully obſerving to leave no vacuum in them, and to keep them free from the mixture of any extraneous body. A hair or a grain of ſand would ſpoil the whole work. When this paſte has not been properly prepared, the porcelain cracks, and melts or becomes warped.

11
And of faſhioning the works.

All plain works are faſhioned with the wheel. When a cup has undergone this operation, the outſide of its bottom is quite round. The workman firſt gives it the requiſite height and diameter, and it comes from his hands almoſt the moment he has received it. He is under the neceſſity of uſing expedition, as he is paid not quite a farthing per board, and each board contains 26 pieces. This cup paſſes then to a ſecond workman, who forms its baſe. A little after it is delivered to a third, who applies it to his mould, and gives it a proper form; when he takes it off the mould, he muſt turn it very ſoftly, and be careful not to preſs it more on one ſide than on another; without this precaution it would become warped or disfigured. A fourth workman poliſhes it with a chiſſel, eſpecially around the edges, and diminiſhes its thickneſs, in order to give it a certain degree of tranſparency. At length, after having paſſed through all the hands neceſſary for giving it all its ornaments, it is received, when dry, by the laſt workman, who faſhions its bottom with a chiſſel. It is aſtoniſhing to ſee with what dexterity and expedition the workmen convey theſe vaſes from one to another. We are aſſured, that a piece of porcelain, before it is finiſhed, muſt paſs through the hands of 70 perſons.

12
Large works executed in parts and cemented.

Large works are executed in parts which are faſhioned ſeparately. When all the pieces are finiſhed, and almoſt dry, they are put together and cemented with paſte made of the ſame ſubſtance, and ſoftened with water. Some time after, the ſeams are poliſhed with a knife, both without and within; and when the veſſel is covered with varniſh, it entirely conceals them, ſo that the leaſt trace of them is not to be ſeen. It is in this manner that ſpouts, handles, rings, and other parts of the ſame nature, are added. This is the caſe, particularly in thoſe pieces which are faſhioned upon moulds or modelled with the hands, ſuch as emboſſed works, groteſque images, idols, figures of trees or animals, and buſts, which the Europeans order. All theſe are formed of four or five pieces joined together, which are afterwards brought to perfection with inſtruments proper for carving, poliſhing, and finiſhing, the different traces which the mould has left imperfect. With regard to thoſe flowers and ornaments which are not in relief, they are either engraven or imprinted with a ſtamp. Ornaments in relief prepared ſeparately, are alſo added to pieces of porcelain, almoſt in the ſame manner as lace is put upon a coat.

13
Their manner of painting porcelain;

After a piece of porcelain has been properly faſhioned, it then paſſes into the hands of the painters. Theſe hoa-pei, or painters in porcelain, are equally indigent as the other workmen; they follow no certain plan in their art, nor are they acquainted with any of the rules of drawing; all their knowledge is the effect of practice, aſſiſted by a whimſical imagination. Some of them, however, ſhow no inconſiderable ſhare of taſte in painting flowers, animals, and landſcapes, on porcelain, as well as upon the paper of fans, and the ſilk uſed for filling up the ſquares of lanterns. The labour of painting, in the manufactories of which we have ſpoken, is divided among a great number of hands. The buſineſs of one is entirely confined to tracing out the firſt coloured circle, which ornaments the brims of the veſſel; another deſigns the flowers, and a third paints them; one delineates waters and mountains, and another birds and other animals: human figures are generally the worſt executed.

14 And of making it appear covered with veins.

The tſou-you, which is a kind of oil procured from white flint, has the peculiar property of making thoſe pieces of porcelain upon which it is laid appear to be covered with an infinitude of veins in every direction; at a diſtance one would take them for cracked vaſes, the fragments of which have not been diſplaced. The colour communicated by this oil is a white, ſomewhat inclining to that of aſhes. If it be laid upon porcelain, entirely of an azure blue, it will appear in the ſame manner to be variegated with beautiful veins. This kind of porcelain is called *tſoui-ki*.

25 A ſingular ſecret which they have now loſt.

The Chineſe make vaſes alſo ornamented with a kind of fret-work, perforated in ſuch a manner as to reſemble very fine lace. In the middle is placed a cup proper for holding any liquid; and this cup makes only one body with the former, which appears like lace wrapped round it. The Chineſe workmen had formerly the ſecret of making a ſtill more ſingular kind of porcelain: they painted upon the ſides of the veſſel fiſhes, inſects, and other animals, which could not be perceived until it was filled with water. This ſecret is in a great meaſure loſt: the following part of the proceſs is, however, preſerved. The porcelain, which the workman intends to paint in this manner, muſt be extremely thin and delicate. When it is dry the colour is laid on pretty thick, not on the outſide, as is generally done, but on the inſide. The figures painted upon it, for the moſt part, are fiſhes, as being more analogous to the water with which the veſſel is filled. When the colour is thoroughly dry, it is coated over with a kind of ſize, made from porcelain-earth; ſo that the azure is entirely incloſed between two laminæ of earth. When the ſize becomes dry, the workmen pours ſome oil into the veſſel, and afterwards puts it upon a mould aad applies it to the lath. As this piece of porcelain has received its conſiſtence and body within, it is made as thin on the outſide as poſſible, without penetrating to the colour; its exterior ſurface is then dipped in oil, and when dry it is baked in a common furnace. The art of making theſe vaſes requires the moſt delicate care, and a dexterity which the Chineſe perhaps do not at preſent poſſeſs. They have, however, from time to time made ſeveral attempts to revive the ſecret of this magic painting, but their ſucceſs has been very imperfect. This kind of porcelain is known by the name of *kia-tſing*, "preſſed azure."

16 Their mode of baking porcelain

After the porcelain has received its proper form, its colours, and all the intended ornaments, it is tranſported from the manufactory to the furnace, which is ſituated ſometimes at the other end of King te-tching. In a kind of portico, which is erected before it, may be ſeen heaps of boxes and caſes made of earth, for the purpoſe of incloſing the porcelain. Each piece, however inconſiderable it may be, has its caſe; and the Chineſe workman, by this procedure, imitates nature, which, in order to bring the fruits of the earth to proper maturity, clothes them in a covering, to defend them from the exceſſive heat of the ſun during the day, and from the ſeverity of the cold during the night.

In the bottom of theſe boxes is put a layer of fine ſand, which is covered over with powder of the kao-lin, to prevent the ſand from adhering too cloſely to the bottom of the veſſel. The piece of porcelain is then placed upon this bed of ſand, and preſſed gently down, in order that the ſand may take the form of the bottom of the veſſel, which does not touch the ſides of its caſe: the caſe has no cover. A ſecond, prepared in the ſame manner, and containing its veſſel, is fitted into the firſt, ſo that it entirely ſhuts it, without touching the porcelain which is below; and thus the furnace is filled with piles of caſes, which defend the pieces they contain from the too direct action of the fire.

With regard to ſmall pieces of porcelain, ſuch as tea-cups, they are incloſed in common caſes about four inches in height. Each piece is placed upon a ſaucer of earth about twice as thick as a crown-piece, and equal in breadth to its bottom. Theſe ſmall baſes are alſo ſprinkled over with the duſt of the kao-lin. When the caſes are large, the porcelain is not placed in the middle, becauſe it would be too far removed from the ſides, and conſequently from the action of the fire.

Theſe piles of caſes are put into the furnace, and placed upon a bed of coarſe ſand, half a foot in thickneſs; thoſe which occupy the middle ſpace are at leaſt ſeven feet high. The two boxes which are at the bottom of each pile remain empty, becauſe the fire acts too feebly upon them, and becauſe they are partly covered by the ſand. For the ſame reaſon, the caſe placed at the top of each pile is alſo ſuffered to be empty. The piles which contain the fineſt porcelain are placed in the middle part of the furnace, the coarſeſt are put at its farther extremity; and thoſe pieces which have the moſt body and the ſtrongeſt colouring are near its mouth.

Theſe different piles are placed very cloſely in the furnace; they ſupport each other mutually by pieces of earth, which bind them at the top, bottom, and middle; but in ſuch a manner that a free paſſage is left for the flame to inſinuate itſelf everywhere around them.

17 Nature of their furnaces.

Before each of theſe furnaces for baking porcelain there is a long porch, which conveys air, and ſupplies in certain reſpects the place of a bellows. It ſerves for the ſame purpoſes as the arch of a glaſshouſe. "Theſe furnaces (ſays Father d'Entrecolles), which were formerly only ſix feet in height and the ſame in length, are conſtructed now upon a much larger plan: at preſent they are two fathoms in height, and almoſt four in breadth; and the ſides and roof are ſo thick, that one may lay the hand upon them without being incommoded by the heat. The dome or roof is ſhaped like a funnel, and has a large aperture at the top, through which clouds of flame and ſmoke inceſſantly iſſue. Beſides this principal aperture, there are five others ſmaller, which are covered with broken pots, but in ſuch a manner that the workman can increaſe or diminiſh the heat according as it may be found moſt convenient: through theſe alſo he is enabled to diſcover when the porcelain is ſufficiently baked. Having uncovered that hole which is neareſt the principal aperture, he takes a pair of pincers, and opens one of the caſes: if he obſerves a bright fire in the furnace, if all the caſes be red-hot, and if the colours of the porcelain appear with full luſtre, he judges that it is in a proper ſtate; he then diſcontinues the fire, and entirely cloſes up the mouth of the furnace for ſome time. In the bottom of the furnace there is a deep hearth about two feet in breadth, over which a plank is laid, in order that the workman may enter to arrange the porcelain. When the fire is kindled on this hearth, the mouth of the furnace is immediately cloſed up, and an aperture is left only ſufficient for the admiſſion of faggots about a foot in length, but very narrow. The furnace is firſt heated for a day and night; after which two men keep continually throwing wood into it, and relieve each other by turns: 180 loads are generally conſumed for one baking. As the porcelain is burning hot, the workman employs for the purpoſe of taking it out long ſcarfs or pieces of cloth, which are ſuſpended from his neck."

18 Their different claſſes of porcelain.

The Chineſe divide their porcelain into ſeveral claſſes, according to its different degrees of fineneſs and beauty. The whole of the firſt is reſerved for the emperor. None of theſe works ever come into the hands of the public, unleſs they have blemiſhes or imperfections which render them unworthy of being preſented to the ſovereign. It is much to be doubted whether any of the largeſt and fineſt porcelain of China has ever been brought to Europe; the miſſionaries at leaſt aſſure us that none of that kind is ſold at Canton. The Chineſe ſet ſome value upon the Dreſden porcelain, and ſtill more upon that which comes from the manufactories of France.

19 Porcelain firſt examined ſcientifically by Reaumur.

The illuſtrious Reaumur firſt attended to the manufacture of porcelain as a ſcience, and communicated his reſearches in two memoirs before the Academy of Sciences in 1727 and 1729. He did not ſatiſfy himſelf with conſidering the external appearance, the painting and gilding, which are only ornaments not eſſential to the porcelain, but he endeavoured to examine it internally; and having broken pieces of the Japaneſe, Saxon, and French porcelains, he examined the difference of their grains (which name is given to their internal ſtructure). The grain of the Japaneſe porcelain appeared to him to be fine, cloſe, compact, moderately ſmooth, and ſomewhat ſhining. The grain of the Saxon porcelain was found to be ſtill more campact, not granulous, ſmooth, ſhining like enamel. Laſtly, the porcelain of St Cloud had a grain much leſs cloſe and fine than that of Japan; not, or but little, ſhining; and reſembling the grain of ſugar.

20 Different kinds of it.

From theſe firſt obſervations Mr Reaumur perceived that porcelains differed conſiderably. That he might examine them further, he expoſed them to a violent heat. More eſſential differences than theſe of the grain appeared upon this trial; for the Japaneſe porcelain was unalterable by the fire, and all the European were melted.

21 Its true compoſition diſcovered by Reaumur.

This eſſential difference betwixt the Japaneſe and European porcelains ſuggeſted to Mr Reaumur a very ingenious thought, and in many reſpects true, concerning the nature of porcelain in general. As all porcelains ſomewhat reſemble glaſs in conſiſtence and tranſparency, though they are leſs compact and much leſs tranſparent, Mr Reaumur conſidered them as ſemivitrifications. But every ſubſtance may appear, and may actually be, in a ſemivitrified ſtate in two ways: for, firſt, it may be entirely compoſed of vitrifiable or fuſible matters; and in this caſe, by expoſing it to the action of fire, it will be actually melted or vitrified, if the heat be ſufficiently ſtrong and long continued. But as this change is not made inſtantly eſpecially when the heat is not very violent; and as it paſſes through different ſtages or degrees, which may be more eaſily obſerved as the heat is better managed: hence, by ſtopping in proper time the application of heat to porcelain made in this manner, we may obtain it in an intermediate ſtate betwixt thoſe of crude earths and of completely vitrified ſubſtances, and alſo poſſeſſed of the ſemitranſparency and of the other ſenſible qualities of porcelain. We know alſo, that if ſuch porcelain be expoſed to a ſtronger degree of heat, it will then be completely fuſed and entirely vitrified. But the European porcelains tried by Mr Reaumur had this fuſibility; from which he concluded, that their compoſition is founded upon the abovementioned principle.

In the ſecond place a paſte of porcelain may be compoſed of fuſible and vitrifiable matter, mixed with a certain proportion of another matter which is abſolutely unfuſible in the fires of our furnaces. We may eaſily perceive, that if ſuch a mixture be expoſed to a heat ſufficient to melt entirely the vitrifiable ingredient, that this matter will actually melt: but as it is intermixed with another matter which does not melt, and which conſequently preſerves its conſiſtency and opacity, the whole muſt form a compound partly opaque and partly tranſparent, or rather a ſemitranſparent maſs; that is, a ſemivitrified ſubſtance or porcelain, but of a kind very different from the former; for as the fuſible part of this latter has produced all its effect, and as it has been as much fuſed as it can be during the baking of the porcelain, the compound may be expoſed a ſecond time to a more violent fire, without approaching nearer to a complete vitrification, or without departing from its ſtate of porcelain. But as oriental porcelain has preciſely theſe appearances and properties, Mr Reaumur concludes with reaſon, that it is compoſed upon this principle; and he afterwards confirmed his opinion by undeniable facts.

Mr Reaumur examined the pe-tun-tſe and kao-lin of the Chineſe, and having expoſed them ſeparately to a violent fire, he diſcovered that the pe-tun-tſe had fuſed without addition, and that the kao-lin had given no ſign of fuſibility. He afterwards mixed theſe matters, and formed cakes of them, which by baking were converted into porcelain ſimilar to that of China. Mr Reaumur eaſily found, that the pe-tun-tſe of the Chineſe was a hard ſtone of the kind called *vitrifiable*, but much more fuſible than any of thoſe which were known in Europe; and that the kao-lin was a talky matter, reduced to a very fine powder. From that time he hoped to make a porcelain of the ſame kind as the Chineſe with materials found in France. Whether he could not find any materials equal to thoſe of China, particularly that material analogous to the pe-tun-tſe of the Chineſe, or becauſe other occupations prevented the continuance of his reſearches, we do not know; but we find, from his ſecond memoir upon porcelain that he afterwards attempted to make an artificial pe-tun-tſe, by mixing our vitrifiable ſtones with ſalts capable of rendering them fuſible, or even by ſubſtituting for it glaſs ready formed, and by adding to theſe ſuch ſub-

22 Who converted glaſs into a kind of porcelain.

ſtances as he thought might be ſubſtituted for kao-lin. But he probably found he could not execute theſe intentions; for he did not reſume this ſubject from the year 1729 to 1739, when he gave a proceſs for converting common glaſs to a ſingular kind of porcelain, to which he had given his name, and of which an account is given under Chemistry, n° 591—594. See alſo the article *Glass-Porcelain*

23 He is miſtaken in ſome particulars.

Although Mr Reaumur has ſurmounted many difficulties, and has given juſt notions concerning this ſubject, yet he has been miſtaken, or rather miſled, in two important points. His firſt error concerns the Saxon porcelains which he confounds with the other fuſible porcelains made in Europe. Formerly, indeed a porcelain might be made in Saxony, compoſed entirely of fuſible or vitrifiable materials, the vitrification of which was ſtopt in proper time, and which Mr Reaumur had examined. But now we are certainly informed, that all of that country is capable of reſiſting the moſt violent fires without fuſion, as well at leaſt as thoſe of China and Japan. Mr Reaumur might have been miſled by the appearance of the internal texture of this porcelain. For when a piece of it is broken, its internal ſurface does not appear granulous, but compact, uniform, ſmooth, ſhining, and much reſembling white enamel. But this appearance, ſo far from ſhowing that Saxon porcelain is a fuſed or vitrified ſubſtance, proves that it is not entirely compoſed of fuſible matters. All who have conſidered attentively this ſubject know, that the internal ſurface of the moſt fuſible porcelains is alſo the leaſt denſe and leaſt compact; the reaſon of which is, that no vitreous matter can be ſmooth and denſe internally, unleſs it has been completely fuſed. But if the denſity and ſhining appearance of the internal ſurface of the Saxon porcelain were only the effects of the fuſion of a vitreous matter, how could we conceive that veſſels formed of that matter ſhould have ſuſtained the neceſſary fuſion for giving this denſity and ſhining appearance, without having entirely loſt their ſhape? The impoſſibility of this is evident to any perſons who have been converſant in theſe matters and in the fuſion of glaſs.

24 Difference between Saxon and oriental porcelain.

This quality of the Saxon porcelain muſt therefore proceed from another cauſe. Its does indeed contain, as every porcelain does, particularly thoſe of China and Japan, a fuſible ſubſtance, which has been even completely fuſed during the baking. Its denſity alſo, and its internal luſtre, proceed chiefly from this fuſed matter: but we are alſo certain, that it contains a large quantity of a ſubſtance abſolutely unfuſible, from which it receives its admirable whiteneſs, its firmneſs and ſolidity, during the baking; in a word, which ſupplies the place of the oriental kao-lin, and which has the property of contracting its dimenſions conſiderably while it incorporates with the fuſible ſubſtance. If it be ſubjected to the moſt deciſive trial, namely, the action of a violent fire, capable of melting every porcelain compoſed of fuſible matters alone, "I affirm (ſays Mr Macquer), after many experiments, that it cannot be fuſed, unleſs by a fire capable alſo of melting the beſt Japaneſe porcelain." The Saxon porcelain is therefore not to be confounded with thoſe which are vitreous and fuſible; but is in its kind as excellent as that of Japan, and perhaps ſuperior, as we ſhall ſee when we enumerate the qualities which conſtitute the excellence of porcelain. The ſubject of Mr Reaumur's ſecond error, or at leaſt that which he has not ſufficiently explained, is the kao-lin of China. According to him, this matter is a fine talky powder, from the mixture of which with pe-tun-tſe the oriental porcelain is formed. Poſſibly a very finely ground talky ſubſtance mixed with pe-tun-tſe might form a porcelain ſimilar to the oriental; but perſons acquainted with the manufacture of any porcelain muſt perceive the impoſſibility of forming veſſels, unleſs the paſte of which they are made be ſo ductile and tenacious that it may be worked upon a potter's lathe, or at leaſt that it may be moulded. But talks, or any kinds of ſtones, however finely ground, cannot acquire the requiſite tenacity, which clays only, of all known earthy ſubſtances, poſſeſs. The Chineſe porcelain veſſels evidently appear to be turned upon the lathe, ſince they retain the marks of it: hence they muſt have been formed of a very tenacious paſte, and conſequently the kao-lin is not a purely talky matter, but is mixed with clay; or elſe the pe-tun-tſe and kao-lin are not, as Mr Reaumur ſuppoſes, the only ingredients of which Chineſe porcelain is formed, but a ſufficient quantity of ſome binding matter, unknown to Father d'Entrecolles and Mr Reaumur, muſt be alſo added.

Chem. Dict.

25 Manufactories of porcelain in different countries.

Although, ſince Mr Reaumur, no ſcientific perſon has written concerning porcelain, many have attempted to make it. Manufactories have been eſtabliſhed in almoſt all the ſtates of Europe. Beſides that of Saxony, which has been long eſtabliſhed, porcelain is alſo made at Vienna, at Frankendal, and lately in the neighbourhood of Berlin. All theſe German porcelains are ſimilar to the Saxon; and are made of materials of the ſame kind, although they differ ſomewhat from each other. England and Italy alſo have their porcelains, the chief of which are thoſe of Chelſea and of Naples. M. de la Condamine, in his laſt journey into Italy, viſited a manufacture of porcelain eſtabliſhed at Florence by the marquis de la Ginori, then governor of Leghorn. M. de la Condamine obſerved particularly the large ſize of ſome pieces of this porcelain. He ſays he ſaw ſtatues and groups half as large as nature, modelled from ſome of the fineſt antiques. The furnaces in which the porcelain was baked were conſtructed with much art, and lined with bricks made of the porcelain materials. The paſte of this porcelain is very beautiful; and from the grain of broken pieces, it appears to have all the qualities of the beſt Chineſe porcelain. A whiter glazing would be deſirable, which they might probably attain, if the Marquis Ginori was not determined to uſe thoſe materials only which were found in that country.

But in no ſtate of Europe have ſuch attempts been made to diſcover porcelain, or ſo many manufactories of it been eſtabliſhed, as in France. Before even Mr Reaumur had publiſhed on this ſubject, porcelain was made at St Cloud, and in the ſuburb of St Antoine at Paris, which was of the vitreous and fuſible kind, but conſiderably beautiful. Since that time, conſiderable manufactories of it have been eſtabliſhed, at Chantilly, at Villeroi, and at Orleans; the porcelains of which have a diſtiguiſhed merit. But the porcelain produced in the manufacture at Sevres holds at preſent the firſt rank from its ſhining white, its beautiful glazing, and coloured gounds, in which no porcelain has ever equalled it. The magnificence of the gilding, the regularity and elegance of its forms, ſurpaſs every thing of the kind.

26 M. Guettard's diſcoveries.

Mr Guettard has publiſhed an account of his diſcoveries on this ſubject, in the Memoirs of the Academy of Sciences for the year 1765. The kao-lin which he employed was a white argillaceous earth, filled wih mica, which he found in the neighbourhood of Alençon; and his pe-tun-tſe is a hard, quartzoſe, grit ſtone, found abundantly in the ſame country, with which the ſtreets of Alençon are paved. We alſo know that Mr Guettard had begun to make his experiments on porcelain with theſe materials in the year 1751, together with the then Duke of Orleans, to whom he was attached. The Count de Lauraguais, of the Academy of Sciences, engaged in the purſuit of porcelain for ſeveral years with uncommon ardour and conſtancy. He ſpared no trouble nor expence to attain his purpoſe, which was to make porcelain equal in all reſpects to that of China and Japan. He ſhowed ſome pieces made by him in the year 1766 to the members of the Academy of Sciences. The perſons appointed by them to examine it gave their opinion, "that of all the porcelains made in the country, that of the Count de Lauraguais moſt reſembles the porcelain of China and Japan in ſolidity, grain, and unfuſibility." It were to be wiſhed that it poſſeſſed equally the other qualities eſſential to the excellence of porcelain, namely, the whiteneſs and luſtre obſervable in the ancient Japaneſe porcelain.

27 In what the perfection of porcelain conſiſts.

We ſhall now ſhow what thoſe qualities are which conſtitute the perfection of porcelain. We muſt firſt carefully diſtinguiſh the qualities which only contribute to the beauty and external appearance, from the intrinſic and eſſential properties in which the goodneſs and ſolidity of porcelain conſiſt. All perſons who have made experiments in this way have ſoon diſcovered the poſſibility of making compounds very white, beautifully ſemi-tranſparent, and covered with a ſhining glazing; but which cannot be worked for want of tenacity, are not ſufficiently compact, are eſſentially fuſible, are ſubject to break by ſudden application of heat and cold; and, laſtly, the glazing of which cracks, becomes rough, and conſequently loſes its luſtre by uſe, becauſe it is too ſoft.

On the other ſide, we ſhall alſo find it not difficult to compoſe very tenacious paſtes which ſhall be capable of being eaſily worked and well baked; which in the baking ſhall acquire the deſirable hardneſs and denſity; which are unfuſible, and capable of ſuſtaining very well the ſudden change of heat and cold; and, in a word, which ſhall have all the qualities of the moſt excellent porcelain excepting whiteneſs and beauty. We ſhall ſoon ſee that the materials fit for the compoſition of ſuch porcelains may be found abundantly in every country. The only difficulty, then, in this inquiry concerning porcelain, is to unite beauty and goodneſs in one compoſition; and indeed nature ſeems to be very ſparing of materials fit for this purpoſe, and therefore perfect porcelain will always be a dear and valuable commodity.

28 Stone-ware a kind of porcelain.

Thoſe potteries which we call *ſtone-ware* are not of modern invention, and have all the eſſential qualities of the beſt Japaneſe. For if we except whiteneſs, on which alone the ſemi-tranſparency depends, and compare all the properties of Japaneſe porcelain with thoſe of the ſtone-ware, no difference can be found betwixt them. The ſame grain appears internally in both; the ſame ſound is produced by ſtriking them when properly ſuſpended; the ſame denſity, the ſame hardneſs by which they ſtrike fire with ſteel, the ſame faculty of ſuſtaining the heat of boiling liquors without breaking, and the ſame unfuſibility in fire, are obſervable. Laſtly, if the earths of which ſtone-ware is made were free from heterogeneous colouring matters, which prevent their whiteneſs and ſemi-tranſparency; if veſſels were carefully formed; if all the proper attentions were given; and if theſe veſſels were covered over with a fine glazing—they would be as perfect porcelain as that of Japan. The moſt perfect porcelain, therefore, is nothing elſe than a fine white ſtone-ware.

29 Genuine porcelain made in ſome countries of Europe.

Earths of this kind are probably more rare in Europe than in Japan and China. And probably alſo the want of theſe earths was the cauſe that the firſt makers of porcelain in Britain confined themſelves to an external imitation, by employing nothing but vitrifiable matters with fuſible ſalts and a ſmall quantity of white earth, from which fuſible and vitreous porcelains were compoſed, which might be called *falſe porcelains*. But things are much changed ſince theſe firſt attempts. Beſides the diſcoveries of the Count de Lauraguais and of Mr Guettard, genuine white porcelains have been made a long time ago in Germany, eſpecially in Saxony and at Frankendal.

Theſe porcelains are not inferior in any reſpect to the oriental; they are even much ſuperior in beauty and whiteneſs to the modern oriental porcelain, which has much degenerated in theſe reſpects; they ſeem even to excel the oriental in the moſt valuable quality of porcelain, namely, the property of ſuſtaining the ſudden change of heat and cold. We cannot judge of the quality of porcelain by a ſlight trial: for ſo many circumſtances concur to make a piece of porcelain capable or incapable of ſuſtaining the ſudden application of heat and of cold, that if at the ſame time boiling water be poured into two veſſels, one of which is good porcelain and the other bad, the former may poſſibly break and the latter remain entire. The only true method of diſcovering good porcelain in this reſpect is, to examine ſeveral pieces of it which are daily uſed; for inſtance, a ſet of coffee-cups. But it has been obſerved, that in many ſuch pieces of oriental porcelain, which have been long and daily uſed, cracks in the direction of their height may be always perceived, which are never ſeen in the good European porcelains.

30 Excellency of the ancient Japaneſe porcelain.

Every one talks of porcelain, and yet few are connoiſſeurs of it. None can be conſidered as ſuch but thoſe who have long made it an object of their inquiries. That the ancient Japaneſe porcelain is the moſt perfect is a general opinion. This porcelain is indeed very beautiful, and we muſt alſo acknowledge that its quality is excellent. It has been the Britiſh model, and has long been the object of their admiration and emulation; but which they have been never able to equal, and which many perſons believe never can be equalled. Some perſons even decry the Saxon porcelain for a quality which really gives it a ſuperiority to the Japaneſe, namely, the greater ſmoothneſs, luſtre, and leſs granulous appearance of its internal ſurface than the oriental. The reſemblance of this ſurface to that of glaſs has evidently ſuggeſted this notion; and it would be well founded if the denſity and luſtre of this porcelain proceeded only from a fuſible and vitreous quality; but as they do not, and as this porcelain is as fixed and as unfuſible as the Japaneſe, its denſity, ſo far from being a fault, is a valuable quality: for we muſt allow, that of porcelains equal in other reſpects, thoſe are beſt which are moſt firm and compact. Hence the interior ſubſtance of the Japaneſe porcelain is eſteemed for its greater denſity, compactneſs, and luſtre, than the vitreous ſand or fritt porcelains; becauſe theſe qualities indicate greater coheſion, and more intimate incorporation of its parts. For the ſame reaſon alſo the ſuperior denſity of the Saxon porcelain ought to give it the preference to the Japaneſe. Beſides, nothing would be eaſier than to give the Saxon porcelain the granulous texture of the Japaneſe, by mixing with the paſte a certain quantity of ſand. But the perſons who perfected that manufacture were certainly ſenſible that ſuch a conformity to the Japaneſe porcelain would leſſen the merit of theirs: for we know, that in general porcelains are better in proportion as they contain a larger proportion of clay or earth, and leſs of ſand, flints, or other matters of that kind.

What we have ſaid concerning porcelain in general, and the principal kinds of it, ſeem ſufficient to give juſt notions of it, if not to perſons who without conſidering the ſubject are determined to prefer the moſt ancient, to thoſe, at leaſt, who have made experiments on this ſubject, or who, having a ſufficient knowledge of chemiſtry, are capable of ſtudying and examining it thoroughly. We ſhall finiſh this article by giving a ſhort deſcription of the method of manufacturing porcelain as practiſed in Europe.

31 Of making fuſible or vitreous porcelains.

The baſis of the porcelains which we have called *fuſible, vitreous*, or *falſe porcelains*, is called by artiſts a *fritt;* which is nothing elſe than a mixture of ſand or of powdered flints, with ſalts capable of diſpoſing them to fuſion, and of giving them a great whiteneſs by means of a ſufficient heat. This fritt is to be then mixed with as much, and no more, of a white tenacious earth of an argillaceous or marly nature, than is ſufficient to make it capable of being worked upon the wheel. The whole mixture is to be well ground together in a mill, and made into a paſte, which is to be formed, either upon the wheel or in moulds, into pieces of ſuch forms as are required.

Each of theſe pieces, when dry, is to be put into a caſe made of earthen ware (A); which caſes are to be ranged in piles one upon another, in a furnace or kiln, which is to be filled with theſe to the roof. The furnaces are chambers or cavities of various forms and ſizes; and are ſo diſpoſed, that their fire-place is placed on the outſide oppoſite to one or more openings, which communicate within the furnace. The flame of the fuel is drawn within the furnace, the air of which rareſying, determines a current of air from without inwards, as in all furnaces. At firſt a very little fire is made, that the furnace may be heated gradually, and is to be increaſed more and more till the porcelain is baked, that is, till it has acquired its proper hardneſs and tranſparency; which is known by taking out of the furnace from time to time, and examining, ſmall pieces of porcelain, placed for that purpoſe in caſes which have lateral openings. When theſe pieces ſhow that the porcelain is ſufficiently baked, the firſt is no longer to be ſupplied with fuel, the furnace is to be cooled, and the porcelain taken out, which in this ſtate reſembles white marble not having a ſhining ſurface, which is afterwards to be given by covering them with a vitreous compoſition called the *glazing*.

32 Porcelain ſculptures.

The porcelain when baked and not glazed is called *biſcuit*, which is more or leſs beautiful according to the nature of the porcelain. The manufacture of Sévres excels all others in this reſpect, and it is therefore the only one which can produce very fine pieces of ſculpture; that is, in which all the fineneſs of the workmanſhip is preſerved, and which are preferable in ſmoothneſs and whiteneſs to the fineſt marble in Italy.

As no piece of ſculpture of this kind can preſerve all the delicacy of its workmanſhip when covered with a glazing, and as ſculptors avoid poliſhing their marble figures, becauſe the luſtre of the poliſh is diſadvantageous; therefore, in the manufactures of Sévres, all figures or little ſtatues, and even ſome ornamental vaſes, are left in the ſtate of biſcuit. The other pieces of porcelain are to be glazed in the following manner.

33 Method of glazing or colouring porcelain.

A glaſs is firſt to be compoſed ſuited to the nature of the porcelain to which it is to be applied; for every glaſs is not fit for this purpoſe. We frequently find that a glaſs which makes a fine glazing for one porcelain ſhall make a very bad glazing for another porcelain; ſhall crack in many places, ſhall have no luſtre, or ſhall contain bubbles. The glazing, then, muſt be appropriated to each porcelain, that is, to the hardneſs and denſity of the ware, and to the ingredients of its compoſition, &c.

Theſe glazings are prepared by previouſly fuſing together all the ſubſtances of which they conſiſt, ſo as to form vitreous maſſes. Theſe maſſes are to be ground very finely in a mill. This vitreous powder is to be mixed with a ſufficient quantity of water, or other proper liquor, ſo that the mixture ſhall have the conſiſtence of cream of milk. The pieces of porcelain are to be covered with a thin ſtratum of this matter; and when very dry, they are to be again put into the furnace in the ſame manner as before for the forming of the biſcuit, and to be continued there till the glazing be well fuſed. The neceſſary degree of fire for fuſing the glazing is much leſs than that for baking the paſte.

The pieces of porcelain which are intended to remain white are now finiſhed; but thoſe which are to be painted and gilded muſt undergo further operations. The colours to be applied are the ſame as thoſe uſed for enamel painting. They all conſiſt of metallic calces bruiſed and incorporated with a very fuſible glaſs. Crocus

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(A) The caſes are called by Engliſh potters *ſeggars*. They are generally formed of coarſer clays, but which muſt be alſo capable of ſuſtaining the heat required without fuſion. By means of theſe caſes the contained porcelain is preſerved from the ſmoke of the burning fuel. The whiteneſs of the porcelain depends much on their compactneſs of texture, by which the ſmoke is excluded, and on the purity of the clay of which they are made.

cus of iron furniſhes a red colour; gold * precipitated by tin makes the purple and violet; copper calcined by acids and precipitated by an alkali gives a fine green; zaffre makes the blue; earths ſlightly ferruginous produce a yellow; and, laſtly, brown and black colours are produced by calcined iron, together with a deep blue of zaffre. Theſe colours being ground with gum-water, or with oil of ſpike, are to be employed for the painting of the porcelain with deſigns of flowers and other figures. For gilding, a powder or calx of gold is to be applied in the ſame manner as the coloured enamels. The painted and gilded porcelains are to be then expoſed to a fire capable of fuſing the glaſs, with which the metallic colours are mixed. Thus the colours are made to adhere, and at the ſame time acquire a gloſs equal to that of the glazing. The gold alone has not then a ſhining appearance, which muſt be afterwards given to it by burniſhing with a blood-ſtone.

* See Chemiſtry, n° 227.

34 Preparation of unfuſible porcelain.

The operations for the unfuſible porcelains, and alſo for ſuch as are of the nature of ſtone-ware, are ſomewhat more ſimple. The ſands and ſtones which enter into their compoſition are to be ground in a mill: the earths or clays are to be waſhed: the materials are to be well mixed, and formed into a paſte: the pieces are firſt rudely formed upon a potter's wheel; and when dry, or half dry, they are turned again upon the wheel, and their form is made more perfect: they are then placed in the furnace; not to bake them, but only to apply a ſufficient heat to give them ſuch a ſolidity that they may be handled without breaking, and may receive the glazing. As the pieces of porcelain after this ſlight heat are very dry, they imbibe water readily. This diſpoſition aſſiſts the application of the glazing. The vitrifiable or vitrified matter of this glazing, which has been previouſly ground in a mill, is to be mixed with ſuch a quantity of water, that the liquor ſhall have the conſiſtence of milk. The pieces of porcelain are haſtily dipt in this liquor, the water of which they imbibe, and thus on their ſurface is left an uniform covering of the glazing materials. This covering, which ought to be very thin, will ſoon become ſo dry, that it cannot ſtick to the fingers when the pieces are handled.

The pieces of this porcelain are then put into the furnace to be perfectly baked. The heat is to be raiſed to ſuch a height, that all within the furnace ſhall be white, and the caſes ſhall be undiſtinguiſhable from the flame. When, by taking out ſmall pieces, the porcelain is known to be ſufficiently baked, the fire is diſcontinued, and the furnace cooled. If the baking has been well performed, the pieces of porcelain will be found by this ſingle operation to be rendered compact, ſonorous, cloſe-grained, moderately gloſſy, and covered externally with a fine glazing. The painting and gilding of this porcelain are to be executed in a manner ſimilar to that already deſcribed.

Porcelain-Shell, a ſpecies of Cypræa.

PORCH, in architecture, a kind of veſtibule ſupported by columns; much uſed at the entrance of the ancient temples, halls, churches, &c.

A porch, in the ancient architecture, was a veſtibule, or a diſpoſition of inſulated columns uſually crowned with a pediment, forming a covert place before the principal door of a temple or court of juſtice. Such is that before the door of St Paul's, Covent-Garden, the work of Inigo Jones. When a porch had four columns in front, it was called a *tetraſtyle*; when ſix, *hexaſtyle*; when eight, *octoſtyle*, &c.

Porch, in Greek στοα, a public portico in Athens adorned with the pictures of Polygnotus and other eminent painters. It was in this portico that Zeno the philoſopher taught; and hence his followers were called *Stoics*. See Stoics and Zeno.

PORCUPINE, in zoology. See Hystrix.

Porcupine-Man, the name by which one Edward Lambert, who had a diſtempered ſkin, went in London. We have the following account of him in the Philoſophical Tranſactions for 1755, by Mr Henry Baker, F. R. S. "He is now (ſays he) 40 years of age, and it is 24 years ſince he was firſt ſhown to the ſociety. The ſkin of this man, except on his head and face, the palms of his hands, and the ſoles of his feet, is covered with excreſcences that reſemble an innumerable company of warts, of a brown colour and cylindrical figure; all riſing to an equal height, which is about an inch, and growing as cloſe as poſſible to each other at their baſis; but ſo ſtiff and elaſtic as to make a ruſtling noiſe when the hand is drawn over them. Theſe excreſcences are annually ſhed, and renewed in ſome of the autumn or winter months. The new ones, which are of a paler colour, gradually riſe up from beneath as the old ones fall off; and at this time it has been found neceſſary for him to loſe a little blood, to prevent a ſlight ſickneſs which he had been uſed to ſuffer before this precaution was taken. He has had the ſmallpox, and he has been twice ſalivated, in hopes to get rid of this diſagreeable covering; but though juſt when the puſtules of the ſmallpox had ſcaled off, and immediately after his ſalivations, his ſkin appeared white and ſmooth, yet the excreſcences ſoon returned by a gradual increaſe, and his ſkin became as it was before. His health, during his whole life, has been remarkably good: but there is one particular of this caſe more extraordinary than all the reſt; this man has had ſix children, and all of them had the ſame rugged covering as himſelf, which came on like his own about nine weeks after the birth. Of theſe children only one is now living, a pretty boy, who was ſhewn with his father. It appears, therefore, as Mr Baker remarks, that a race of people might be propagated by this man, as different from other men as an African is from an Engliſhman; and that if this ſhould have happened in any former age, and the accidental original have been forgotten, there would be the ſame objections againſt their being derived from the ſame common ſtock with others: it muſt therefore be admitted poſſible, that the differences now ſubſiſting between one part of mankind and another may have been produced by ſome ſuch accidental cauſe, long after the earth has been peopled by one common progenitor."

PORE, in anatomy, a little interſtice or ſpace between the parts of the ſkin, ſerving for perſpiration.

PORELLA, in botany; a genus of the natural order of muſci, belonging to the cryptogamia claſs of plants. The antheræ are multilocular, full of natural pores, with an operculum; there is no calyptra, nor pedicle; the capſules contain a powder like thoſe of the other moſſes; and their manner of ſhedding this powder is not by ſeparating into two parts, like thoſe of the ſelago and lycopodium, but by opening into ſeveral holes on all ſides.

PORENTRU, is a town of Swiſſerland, in Elſgaw, and capital of the territory of the biſhop of Baſle. It has a good caſtle, where he reſides. It has in it, however, nothing elſe worth taking notice of, except the cathedral. The biſhop is a prince of the empire. It is ſeated on the river Halle, near mount Jura, 22 miles ſouth of Baſle. E. Long. 7. 2. N. Lat. 47. 34.

PORISM, in geometry, is a name given by the ancient geometers to two claſſes of mathematical propoſitions. Euclid gives this name to propoſitions which are involved in others which he is profeſſedly inveſtigating, and which, although not his principal object, are yet obtained along with it, as is expreſſed by their name *poriſmata*, "acquiſitions." Such propoſitions are now called *corollaries*. But he gives the ſame name, by way of eminence, to a particular claſs of propoſitions which he collected in the courſe of his reſearches, and ſelected from among many others on account of their great ſubſerviency to the buſineſs of geometrical inveſtigation in general. Theſe propoſitions were ſo named by him, either from the way in which he diſcovered them, while he was inveſtigating ſomething elſe, by which means they might be conſidered as gains or acquiſitions, or from their utility in acquiring farther knowledge as ſteps in the inveſtigation. In this ſenſe they are poriſmata; for πορίζω ſignifies both to inveſtigate and to acquire by inveſtigation. Theſe propoſitions formed a collection, which was familiarly known to the ancient geometers by the name of Euclid's *poriſms*; and Pappus of Alexandria ſays, that it was a moſt ingenious collection of many things conducive to the analyſis or ſolution of the moſt difficult problems, and which afforded great delight to thoſe who were able to underſtand and to inveſtigate them.

Unfortunately for mathematical ſcience, however, this valuable collection is now loſt, and it ſtill remains a doubtful queſtion in what manner the ancients conducted their reſearches upon this curious ſubject. We have, however, reaſon to believe that their method was excellent both in principle and extent, for their analyſis led them to many profound diſcoveries, and was reſtricted by the ſevereſt logic. The only account we have of this claſs of geometrical propoſitions, is in a fragment of Pappus, in which he attempts a general definition of them as a ſet of mathematical propoſitions diſtinguiſhable in kind from all others; but of this diſtinction nothing remains, except a criticiſm on a definition of them given by ſome geometers, and with which he finds fault, as defining them only by an accidental circumſtance, "*Poriſma eſt quod deficit hypotheſi a theoremate locali.*"

Pappus then proceeds to give an account of Euclid's poriſms; but the enunciations are ſo extremely defective, at the ſame time that they refer to a figure now loſt, that Dr Halley confeſſes the fragment in queſtion to be beyond his comprehenſion.

The high encomiums given by Pappus to theſe propoſitions have excited the curioſity of the greateſt geometers of modern times, who have attempted to diſcover their nature and manner of inveſtigation. M. Fermat, a French mathematician of the laſt century, attaching himſelf to the definition which Pappus criticiſes, publiſhed an introduction (for this is its modeſt title) to this ſubject, which many others tried to elucidate in vain. At length Dr Simſon of Glaſgow, by patient inquiry and ſome lucky thoughts, obtained a reſtoration of the poriſms of Euclid, which has all the appearance of being juſt. It preciſely correſponds to Pappus's deſcription of them. All the lemmas which Pappus has given for the better underſtanding of Euclid's propoſitions are equally applicable to thoſe of Dr Simſon, which are found to differ from local theorems preciſely as Pappus affirms thoſe of Euclid to have done. They require a particular mode of analyſis, and are of immenſe ſervice in geometrical inveſtigation; on which account they may juſtly claim our attention.

While Dr Simſon was employed in this inquiry, he carried on a correſpondence upon the ſubject with the late Dr M. Stewart, profeſſor of mathematics in the univerſity of Edinburgh; who, beſides entering into Dr Simſon's views, and communicating to him many curious poriſms, purſued the ſame ſubject in a new and very different direction. He publiſhed the reſult of his inquiries in 1746, under the title of General Theorems, not caring to give them any other name, leaſt he might appear to anticipate the labours of his friend and former preceptor. The greater part of the propoſitions contained in that work are poriſms, but without demonſtrations; therefore, whoever wiſhes to inveſtigate one of the moſt curious ſubjects in geometry, will there find abundance of materials, and an ample field for diſcuſſion.

Dr Simſon defines a poriſm to be "a propoſition, in which it is propoſed to demonſtrate, that one or more things are given, between which, and every one of innumerable other things not given, but aſſumed according to a given law, a certain relation deſcribed in the propoſition is ſhown to take place."

This definition is not a little obſcure, but will be plainer if expreſſed thus: "A poriſm is a propoſition affirming the poſſibility of finding ſuch conditions as will render a certain problem indeterminate, or capable of innumerable ſolutions." This definition agrees with Pappus's idea of theſe propoſitions, ſo far at leaſt as they can be underſtood from the fragment already mentioned; for the propoſitions here defined, like thoſe which he deſcribes, are, ſtrictly ſpeaking, neither theorems nor problems, but of an intermediate nature between both; for they neither ſimply enunciate a truth to be demonſtrated, nor propoſe a queſtion to be reſolved, but are affirmations of a truth in which the determination of an unknown quantity is involved. In as far, therefore, as they aſſert that a certain problem may become indeterminate, they are of the nature of theorems; and, in as far as they ſeek to diſcover the conditions by which that is brought about, they are of the nature of problems.

We ſhall endeavour to make our readers underſtand this ſubject, diſtinctly, by conſidering them in the way in which it is probable they occurred to the ancient geometers in the courſe of their reſearches: this will at the ſame time ſhow the nature of the analyſis peculiar to them, and their great uſe in the ſolution of problems.

It appears to be certain, that it has been the ſolution of problems which, in all ſtates of the mathematical ſciences, has led to the diſcovery of geometrical truths: the firſt mathematical inquiries, in particular, muſt have occurred in the form of queſtions, where ſomething was given, and ſomething required to be done; and by the reaſoning neceſſary to anſwer theſe queſtions, or to diſcover the relation between the things given and thoſe to be found, many truths were ſuggeſted, which came afterwards to be the ſubject of ſeparate demonſtrations.

The number of theſe was the greater, becauſe the ancient geometers always undertook the ſolution of problems, with a ſcrupulous and minute attention, inſomuch that they would ſcarcely ſuffer any of the collateral truths to eſcape their obſervation.

Now, as this cautious manner of proceeding gave an opportunity of laying hold of every collateral truth connected with the main object of inquiry, theſe geometers ſoon perceived, that there were many problems which in certain caſes would admit of no ſolution whatever, in conſequence of a particular relation taking place among the quantities which were given. Such problems were ſaid to become impoſſible: and it was ſoon perceived, that this always happened when one of the conditions of the problem was inconſiſtent with the reſt. Thus, when it was required to divide a line, ſo that the rectangle contained by its ſegments might be equal to a given ſpace, it is evident that this was poſſible only when the given ſpace was leſs than the ſquare of half the line; for when it was otherwiſe, the two conditions defining, the one the magnitude of the line, and the other the rectangle of its ſegments, were inconſiſtent with each other. Such caſes would occur in the ſolution of the moſt ſimple problems; but if they were more complicated, it muſt have been remarked, that the conſtructions would ſometimes fail, for a reaſon directly contrary to that juſt now aſſigned. Caſes would occur, where the lines, which by their interſection were to determine the thing ſought, inſtead of interſecting each other as they did commonly, or of not meeting at all as in the abovementioned caſe of impoſſiblity, would coincide with one another entirely, and of courſe leave the problem unreſolved. It would appear to geometers upon a little reflection, that ſince, in the caſe of determinate problems, the thing required was determined by the interſection of the two lines already mentioned, that is, by the points common to both; ſo in the caſe of their coincidence, as all their parts were in common, every one of theſe points muſt give a ſolution, or, in other words, the ſolutions muſt be indefinite in number.

Upon inquiry, it would be found that this proceeded from ſome condition of the problem having been involved in another, ſo that, in fact, there was but one, which did not leave a ſufficient number of independent conditions to limit the problem to a ſingle or any determinate number of ſolutions. It would ſoon be perceived, that theſe caſes formed very curious propoſitions of an intermediate nature between problems and theorems; and that they admitted of being enunciated in a manner peculiarly elegant and conciſe. It was to ſuch propoſitions that the ancients gave the name of *poriſms*. This deduction requires to be illuſtrated by an example: ſuppoſe, therefore, that it were required to reſolve the following problem.

Plate CCCCXIII.

A circle ABC (fig. 1.), a ſtraight line DE, and a point F, being given in poſition, to find a point G in the ſtraight line DE ſuch, that GF, the line drawn from it to the given point, ſhall be equal to GB, the line drawn from it touching the given circle.

Suppoſe G to be found, and GB to be drawn touching the given circle ABC in B, let H be its centre, join HB, and let HD be perpendicular to DE. From D draw DL, touching the circle ABC in L, and join HL; alſo from the centre G, with the diſtance GB or GF, deſcribe the circle BKF, meeting HD in the points K and K. Then HD and DL are given in poſition and magnitude; and becauſe GB touches the circle ABC, HBG is a right angle; and ſince G is the centre of the circle BKF, therefore HB touches the circle BKF, and $HB^2 =$ the rectangle K′HK; which rectangle $+ DK^2 = HD^2$, becauſe K′K is biſected in D, therefore $HL^2 + KD^2 = DH^2 = HL^2$ and $= LD^2$; therefore $DK^2 = DL^2$, and $DK = DL$; and ſince DL is given in magnitude, DK is alſo given, and K is a given point: for the ſame reaſon K′ is a given point, and the point F being given by hypotheſis, the circle BKP is given by poſition. The point G, the centre of the circle, is therefore given, which was to be found. Hence the conſtruction:

Having drawn HD perpendicular to DE, and DL touching the circle ABC, make DK and DK′ each equal to DL, and find G the centre of the circle deſcribed through the points K′FK; that is, let FK′ be joined and biſected at right angles by MN, which meets DE in G, G will be the point required; that is, if GB be drawn touching the circle ABC, and GF to the given point, GB is equal to GF.

The ſynthetical demonſtration is eaſily derived from the preceding analyſis; but it muſt be remarked, that in ſome caſes this conſtruction fails. For, firſt, if F fall anywhere in DH, as at F′ the line MN becomes parallel to DE, and the point G is nowhere to be found; or, in other words, it is at an infinite diſtance from D.—This is true in general; but if the given point F coincides with K, then MN evidently coincides with DE; ſo that, agreeable to a remark already made, every point of the line DE may be taken for G, and will ſatisfy the conditions of the problem; that is to ſay, GB will be equal to GK, wherever the point G be taken in the line DE, the ſame is true if F coincide with K. Thus we have an inſtance of a problem, and that too a very ſimple one, which in general, admits of but one ſolution; but which, in one particular caſe, when a certain relation takes place among the things given, becomes indefinite, and admits of innumerable ſolutions. The propoſition which reſults from this caſe of the problem is a poriſm, and may be thus enunciated:

"A circle ABC being given by poſition, and alſo a ſtraight line DE, which does not cut the circle, a point K may be found, ſuch, that if G be any point whatever in DE, the ſtraight line drawn from G to the point K ſhall be equal to the ſtraight line drawn from G touching the given circle ABC."

The problem which follows appears to have led to the diſcovery of many poriſms.

A circle ABC (fig. 2.) and two points D, E, in a diameter of it being given, to find a point F in the circumference of the given circle; from which, if ſtraight lines be drawn to the given points E, D, theſe ſtraight lines ſhall have to one another the given ratio of α to β, which is ſuppoſed to be that of a greater to a leſs.—Suppoſe the problem reſolved, and that F is found, ſo that FE has to FD the given ratio of α to β, produce EF towards B, biſect the angle EFD by FL, and DFB by FM: therefore EL : LD :: EF : FD, that is in a given ratio, and ſince ED is given, each of the ſegments EL, LD, is given, and the point L is alſo given; becauſe DFB is biſected by FM, EM : MD : : EF : FD, that is, in a given ratio, and therefore M is given. Since DFL is half of DFE, and DFM half of DFB, therefore LFM is half of (DFE+DFB), therefore LFM is a right angle; and ſince the points L, M, are given, the point F is in the circumference of a circle deſcribed upon LM as a diameter, and therefore given in poſition. Now the point F is alſo in the circumference of the given circle ABC, therefore it is in the interſection of the two given circumferences, and therefore is found. Hence this conſtruction: Divide ED in L, ſo that EL may be to LD in the given ratio of α to β, and produce ED alſo to M, ſo that EM may be to MD in the ſame given ratio of α to β; biſect LM in N, and from the centre N, with the diſtance NL, deſcribe the ſemicircle LFM; and the point F, in which it interſects the circle ABC, is the point required.

The ſynthetical demonſtration is eaſily derived from the preceding analyſis. It muſt, however, be remarked, that the conſtruction fails when the circle LFM falls either wholly within or wholly without the circle ABC, ſo that the circumferences do not interſect; and in theſe caſes the problem cannot be ſolved. It is alſo obvious that the conſtruction will fail in another caſe, viz. when the two circumferences LFM, ABC, entirely coincide. In this caſe, it is farther evident, that every point in the circumference ABC will anſwer the conditions of the problem, which is therefore capable of numberleſs ſolutions, and may, as in the former inſtances, be converted into a poriſm. We now inquire, therefore, in what circumſtances the point L will coincide with A, and alſo the point M with C, and of conſequence the circumference LFM with ABC. If we ſuppoſe that they coincide EA : AD : : α : β : : EC : CD, and EA : EC : : AD : CD, or by converſion EA : AC : : AD : CD—AD : : AD : 2DO, O being the centre of the circle ABC; therefore, alſo, EA : AO : : AD : DO, and by compoſition EO : AO : : AO : DO, therefore $EO \times OD = AO^2$. Hence, if the given points E and D (fig. 3.) be ſo ſituated, that $EO \times OD = AO^2$, and at the ſame time α : β : : EA : AD : : EC : CD, the problem admits of numberleſs ſolutions; and if either of the points D or E be given, the other point, and alſo the ratio which will render the problem indeterminate, may be found. Hence we have this poriſm:

Plate CCCCXIII

"A circle ABC, and alſo a point D being given, another point E may be found, ſuch that the two lines inflected from theſe points to any point in the circumference ABC, ſhall have to each other a given ratio, which ratio is alſo to be found." Hence alſo we have an example of the derivation of poriſms from one another, for the circle ABC, and the points D and E remaining as before (fig. 3.), if, through D, we draw any line whatever HDB, meeting the circle in B and H; and if the lines EB, EH, be alſo drawn, theſe lines will cut off equal circumferences BF, HG. Let FC be drawn, and it is plain from the foregoing analyſis, that the angles DFC, CFB, are equal; therefore if OG, OB, be drawn, the angles BOC, COG, are alſo equal; and conſequently the angles DOB, DOG. In the ſame manner, by joining AB, the angle DBE being biſected by BA, it is evident that the angle AOF is equal to AOH, and therefore the angle FOB to HOG, that is, the arch FB to the arch HG. This propoſition appears to have been the laſt but one in the third book of Euclid's Poriſms, and the manner of its enunciation in the poriſmatic form is obvious.

The preceding propoſition alſo affords an illuſtration of the remark, that the conditions of a problem are involved in one another in the poriſmatic or indefinite caſe; for here ſeveral independent conditions are laid down, by the help of which the problem is to be reſolved. Two points D and E are given, from which two lines are to be inflected, and a circumference ABC, in which theſe lines are to meet, as alſo a ratio which theſe lines are to have to each other. Now theſe conditions are all independent on one another, ſo that any one may be changed without any change whatever in the reſt. This is true in general; but yet in one caſe, viz. when the points are ſo related to one another that their rectangle under their diſtances from the centre is equal to the ſquare of the radius of the circle; it follows from the preceding analyſis, that the ratio of the inflected lines is no longer a matter of choice, but a neceſſary conſequence of this diſpoſition of the points.

From what has been already ſaid, we may trace the imperfect definition of a poriſm which Pappus aſcribes to the later geometers, viz. that it differs from a local theorem, by wanting the hypotheſis aſſumed in that theorem.—Now, to underſtand this, it muſt be obſerved, that if we take one of the propoſitions called *loci*, and make the conſtruction of the figure a part of the hypotheſis, we get what was called by the ancient geometers a *local theorem*. If, again, in the enunciation of the theorem, that part of the hypotheſis which contains the conſtruction be ſuppreſſed, the propoſition thence ariſing will be a poriſm, for it will enunciate a truth, and will require to the full underſtanding and inveſtigation of that truth, that ſomething ſhould be found, viz. the circumſtances in the conſtruction ſuppoſed to be omitted.

Thus, when we ſay, if from two given points E, D, (fig. 3.) two ſtraight lines EF, FD, are inflected to a third point F, ſo as to be to one another in a given ratio, the point F is in the circumference of a given circle, we have a locus. But when converſely it is ſaid, if a circle ABC, of which the centre is O, be given by poſition, as alſo a point E; and if D be taken in the line EO, ſo that $EO \times OD = AO^2$; and if from E and D the lines EF, DF be inflected to any point of the circumference ABC, the ratio of EF to DF will be given, viz. the ſame with that of EA to AD, we have a local theorem.

Laſtly, when it is ſaid, if a circle ABC be given by poſition, and alſo a point E, a point D may be found, ſuch that if EF, FD be inflected from E and D to any point F in the circumference ABC, theſe lines ſhall have a given ratio to one another, the propoſition becomes a poriſm, and is the ſame that has juſt now been inveſtigated.

Hence it is evident, that the local theorem is changed into a poriſm, by leaving out what relates to the determination of D, and of the given ratio. But though all propoſitions formed in this way from the converſion of loci, are poriſms, yet all poriſms are not formed from the converſion of loci; the firſt, for inſtance, of the preceding cannot by converſion be changed into a locus;

therefore Fermat's idea of poriſms, founded upon this circumſtance, could not fail to be imperfect.

To confirm the truth of the preceding theory, it may be added, that profeſſor Dr Stewart, in a paper read a conſiderable time ago before the Philoſophical Society of Edinburgh, defines a poriſm to be "A propoſition affirming the poſſibility of finding one or more conditions of an indeterminate theorem;" where, by an indeterminate theorem, he meant one which expreſſes a relation between certain quantities that are determinate and certain others that are indeterminate; a definition which evidently agrees with the explanations which have been here given.

If the idea which we have given of theſe propoſitions be juſt, it follows, that they are to be diſcovered by conſidering thoſe caſes in which the conſtruction of a problem fails, in conſequence of the lines which by their interſection, or the points which by their poſition, were to determine the problem required, happening to coincide with one another. A poriſm may therefore be deduced from the problem to which it belongs, juſt as propoſitions concerning the *maxima* and *minima* of quantities are deduced from the problems of which they form limitations; and ſuch is the moſt natural and obvious analyſis of which this claſs of propoſitions admits.

The following poriſm is the firſt of Euclid's, and the firſt alſo which was reſtored. It is given here to exemplify the advantage which, in inveſtigations of this kind, may be derived from employing the *law of continuity* in its utmoſt extent, and purſuing poriſms to thoſe extreme caſes where the indeterminate magnitudes increaſe *ad infinitum*.

Plate CCCCXIII

This poriſm may be conſidered as having occurred in the ſolution of the following problem: Two points A, B, (fig. 4.) and alſo three ſtraight lines DE, FK, KL, being given in poſition, together with two points H and M in two of theſe lines, to inflect from A and B to a point in the third, two lines that ſhall cut off from KF and KL two ſegments, adjacent to the given points H and M, having to one another the given ratio of α to β. Now, to find whether a poriſm be connected with this problem, ſuppoſe that there is, and that the following propoſition is true. Two points A and B, and two ſtraight lines DE, FK, being given in poſition, and alſo a point H in one of them, a line LK may be found, and alſo a point in it M, both given in poſition, ſuch that AE and BE inflected from the points A and B to any point whatever of the line DE, ſhall cut off from the other lines FK and LK ſegments HG and MN adjacent to the given points H and M, having to one another the given ratio of α to β.

Firſt, let AE′, BE′, be inflected to the point E′, ſo that AE′ may be parallel to FK, then ſhall E′B be parallel to KL, the line to be found; for if it be not parallel to KL, the point of their interſection muſt be at a finite diſtance from the point M, and therefore making as β to α; ſo this diſtance to a fourth proportional, the diſtance from H at which AE′ interſects FK, will be equal to that fourth proportional. But AE′ does not interſect FK, for they are parallel by conſtruction; therefore BE′ cannot interſect KL, which is therefore parallel to BE′, a line given in poſition. Again, let AE′, BE″, be inflected to E″, ſo that AE′ may paſs through the given point H; then it is plain that BE″ muſt paſs through the point to be found M; for if not, it may be demonſtrated juſt as above, that AE″ does not paſs through H, contrary to the ſuppoſition. The point to be found is therefore in the line E′B, which is given in poſition. Now if from E there be drawn EP parallel to AE′, and ES parallel to BE′, BS : SE : : BL : $LN=\frac{SE\times BL}{BS}$, and AP : PE : : AF : $FG=\frac{PE\times AF}{AP}$; therefore FG : LN : : $\frac{PE\times AF}{AP} : \frac{SE\times BL}{BS}$: : PE × AF × BS : SE × BL × AP; wherefore the ratio of FG to LN is compounded of the ratios of AF to BL, PE to ES, and BS to AP; but PE : SE : : AE′ : BE′, and BS : AP : : DB : DA for DB : BS : : DE′ : E′E : : DA : AP; therefore the ratio of FG to LN is compounded of the ratios of AF to BL, AE′ to BE′, and DB to DA. In like manner, becauſe E″ is a point in the line DE and AE″, BE″ are inflected to it, the ratio of FH to LM is compounded of the ſame ratios of AF to BL, AE′ to BE′, and DB to DA; therefore FH : LM : : FG : NL (and conſequently) : : HG : MN; but the ratio of HG to MN is given, being the ſame as that of α to β; the ratio of FH to LM is therefore alſo given, and FH being given, LM is given in magnitude. Now LM is parallel to BE′, a line given in poſition; therefore M is in a line QM, parallel to AB, and given in poſition; therefore the point M, and alſo the line KLM, drawn through it parallel to BE′, are given in poſition, which were to be found. Hence this conſtruction: From A draw AE′ parallel to FK, ſo as to meet DE in E′; join BE′, and take in it BQ, ſo that $\alpha : \beta$: : HF : BQ, and through Q draw QM parallel to AB. Let HA be drawn, and produced till it meet DE in E″, and draw BE″, meeting QM in M; through M draw KML parallel to BE′, then is KML the line and M the point which were to be found. There are two lines which will anſwer the conditions of this poriſm; for if in QB, produced on the other ſide of B, there be taken B*q*=BQ, and if *q m* be drawn parallel to AB, cutting MB in *m*; and if *m n* be drawn parallel to BQ, the part *m n*, cut off by EB produced, will be equal to MN, and have to HG the ratio required. It is plain, that whatever be the ratio of α to β, and whatever be the magnitude of FH, if the other things given remain the ſame, the lines found will be all parallel to BE′. But if the ratio of α to β remain the ſame likewiſe, and if only the point H vary, the poſition of KL will remain the ſame, and the point M will vary.

Another general remark which may be made on the analyſis of poriſms is, that it often happens, as in the laſt example, that the magnitude required may all, or a part of them, be found by conſidering the extreme caſes; but for the diſcovery of the relation between them, and the indefinite magnitudes, we muſt have recourſe to the hypotheſis of the poriſm in its moſt general or indefinite form; and muſt endeavour ſo to conduct the reaſoning, that the indefinite magnitudes may at length totally diſappear, and leave a propoſition aſſerting the relation between determinate magnitudes only.

For this purpoſe Dr Simſon frequently employs two ſtatements of the general hypotheſis, which he compares together. As for inſtance, in his analyſis of the laſt poriſm,

riſm, he aſſumes not only E, any point in the line DE, but alſo another point O, any where in the ſame line, to both of which he ſuppoſes lines to be inflected from the points A, B. This double ſtatement, however, cannot be made without rendering the inveſtigation long and complicated; nor is it even neceſſary, for it may be avoided by having recourſe to ſimpler *poriſms*, or to *loci*, or to propoſitions of the *data*. The following poriſm is given as an example where this is done with ſome difficulty, but with conſiderable advantage both with regard to the ſimplicity and ſhortneſs of the demonſtration. It will be proper to premiſe the following lemma.

Plate CCCXIII.

Let AB (fig. 7.) be a ſtraight line, and D, L any two points in it, one of which D is between A and B; let CL be any ſtraight line. $\frac{LB}{CL}\cdot AD^2+\frac{LA}{CL}\cdot BD^2=\frac{LB}{CL}AL^2+\frac{LA}{CL}\cdot BL^2+\frac{AB}{CL}\cdot DL^2$. Place CL perpendicular to AB, and through the points A, C, B, deſcribe a circle; and let CL meet it again in E, and join AE, BE. Draw DG parallel to CE, meeting AE and BE in H and G. Draw EK parallel to AB. $CL : LB :: (LA : LE ::)\ LA^2 : LA\times LE=\frac{LB}{CL}LA^2$

$CL : LA :: (LB : LE ::)\ LB^2 : LB\times LE=\frac{LA}{CL}\cdot BL^2$

Now $CL : LB :: LA : LE :: (EK)\ LD : KH$, and $CL : LA :: LB : LE :: (EK)\ LD : KG$; therefore, (V. 24.) $CL : AB :: (LD : GH ::)\ LD^2 : EK\times GH=\frac{AB}{CL}\cdot LD^2$; therefore $\frac{LB}{CL}\cdot LA^2+\frac{LA}{CL}L+\frac{AB}{CL}\cdot LD^2=AB\times LE+EK\times GH$. Again, $CL : LA :: (LB : LE :: DB : DG ::)\ DB^2 : DB\times DG=\frac{LA}{CL}\cdot DB^2$, and $CL : LB :: (LA : LE :: DA : DH ::)\ DA^2 : DA\times DH=\frac{LB}{CL}\cdot DA^2$; therefore $\frac{LB}{CL}DA^2+\frac{LA}{CL}DB^2=AD\times DH+DB\times DG=AB\times LE+EK\times GH$; wherefore $\frac{LB}{CL}DA^2+\frac{LA}{CL}DB^2=\frac{LB}{CL}LA^2+\frac{LA}{CL}LB^2+\frac{AB}{CL}LD^2$. *Q. E. D.*

Let there be three ſtraight lines AB, AC, CB given in poſition (fig. 5.); and from any point whatever in one of them, as D, let perpendiculars be drawn to the other two, as DF, DE, a point G may be found, ſuch, that if GD be drawn from it to the point D, the ſquare of that line ſhall have a given ratio to the ſum of the ſquares of the perpendiculars DF and DE, which ratio is to be found.

Draw AH, BK perpendicular to BC and AC; and in AB take L, ſo that $AL : LB :: AH^2 : BK^2 :: AC^2 : CB^2$. The point L is therefore given; and if N be taken, ſo as to have to AL the ſame ratio that AB has to AH^2, N will be given in magnitude. Alſo, ſince $AH^2 : BK^2 :: AL : LB$, and $AH^2 : AB^2 :: AL : N$, *ex equo* $BK^2 : AB^2 :: LB : N$. Draw LO, LM perpendicular to AC, CB; LO, LM are therefore given in magnitude. Now, becauſe $AB^2 : BK^2 :: AD^2 : DF^2$, $N : LB :: AD^2 : DF^2$, and $DF^2=\frac{LB}{N}\cdot AD^2$; and for the ſame reaſon $DE^2=\frac{AL}{N}\cdot BD^2$; but, by the preceding lemma, $\frac{LB}{N}\cdot AD^2+\frac{AL}{N}\cdot BD^2=\frac{LB}{N}\cdot AL^2+\frac{AL}{N}\cdot BL^2+\frac{AB}{N}\cdot DL^2$; that is, $DE^2+DF^2=LO^2+LM^2+\frac{AB}{N}\cdot DL^2$. Join LG then by hypotheſis LO^2+LM^2, as to LG^2, the ſame ratio as DF^2+DE^2 has to DG^2; let it be that of R to N, then $LO^2+LM=\frac{R}{N}\cdot LG^2$; and therefore $DE^2+DF^2=\frac{R}{N}\cdot LG^2+\frac{AB}{N}\cdot DL^2$; but $DE^2+DF^2=\frac{R}{N}\cdot DG^2$; therefore, $\frac{R}{N}\cdot LG^2+\frac{BA}{N}\cdot DL^2=\frac{R}{N}\cdot DG^2$, and $\frac{AB}{N}\cdot DL^2=\frac{R}{N}(DG^2-LG^2)$; therefore DG^2-LG^2 has to DL a conſtant ratio, viz. that of AB to R. The angle DLG is therefore a right angle, and the ratio of AB to R that of equality, otherwiſe LD would be given in magnitude, contrary to the ſuppoſition. LG is therefore given in poſition; and ſince $R : N :: AB : N :: LO^2+LM^2 : LG^2$; therefore the ſquare of LG, and conſequently LG, is given in magnitude. The point G is therefore given, and alſo the ratio of DE^2+DF^2 to DG^2, which is the ſame with that of AB to N.

The conſtruction eaſily follows from the analyſis, but it may be rendered more ſimple; for ſince $AH^2 : AB^2 :: AL : N$, and $BK^2 : AB^2 :: BL : N$; therefore $AH^2+BK^2 : AB^2 :: AB : N$. Likewiſe, if AG, BG, be joined, $AB : N :: AH^2 : AG^2$, and $AB : N :: BK^2 : BG^2$; wherefore $AB : N :: AK^2+BK^2 : AG^2+BG^2$ and $AG^2+BG^2=AB^2$; therefore the angle AGB is a right one, and $AL : LG :: LG : LB$. If therefore AB be divided in L, ſo that $AL : LB :: AH^2 : BK^2$; and if LG, a mean proportional between AL and LB be placed perpendicular to AB, G will be the point required.

The ſtep in the analyſis, by which a ſecond introduction of the general hypotheſis is avoided, is that in which the angle GLD is concluded to be a right angle; which follows from DG^2-GL^2, having a given ratio to LD^2, at the ſame time that LD is of no determinate magnitude. For, if poſſible, let GLD be obtuſe (fig. 6,) and let the perpendicular from G to AB meet it in V, therefore V is given: and ſince $GD^2-LG^2=LD^2+2DL\times LV$; therefore, by the ſuppoſition, $LD^2+2DL\times LV$ muſt have a given ratio to LD^2; therefore the ratio of LD^2 to $DL\times VL$, that is, of LD to VL, is given, ſo that VL being given in magnitude, LD is alſo given. But this is contrary to the ſuppoſition; for LD is indefinite by hypotheſis, and therefore GLD cannot be obtuſe, nor any other than a right angle. The concluſion here drawn immediately from the indetermination of LD would be deduced according to Dr Simſon's method, by aſſuming another point D' and how, and from the ſuppoſition that $GD^2-GL^2 : LD^2 :: GD'^2-GL^2 : LD'^2$, it would eaſily appear that GLD muſt be a right angle, and the ratio that of equality.

Theſe poriſms facilitate the ſolution of the general problems from which they are derived. For example, let three ſtraight lines AB, AC, BC (fig. 5.), be given in poſi-

PORISM.

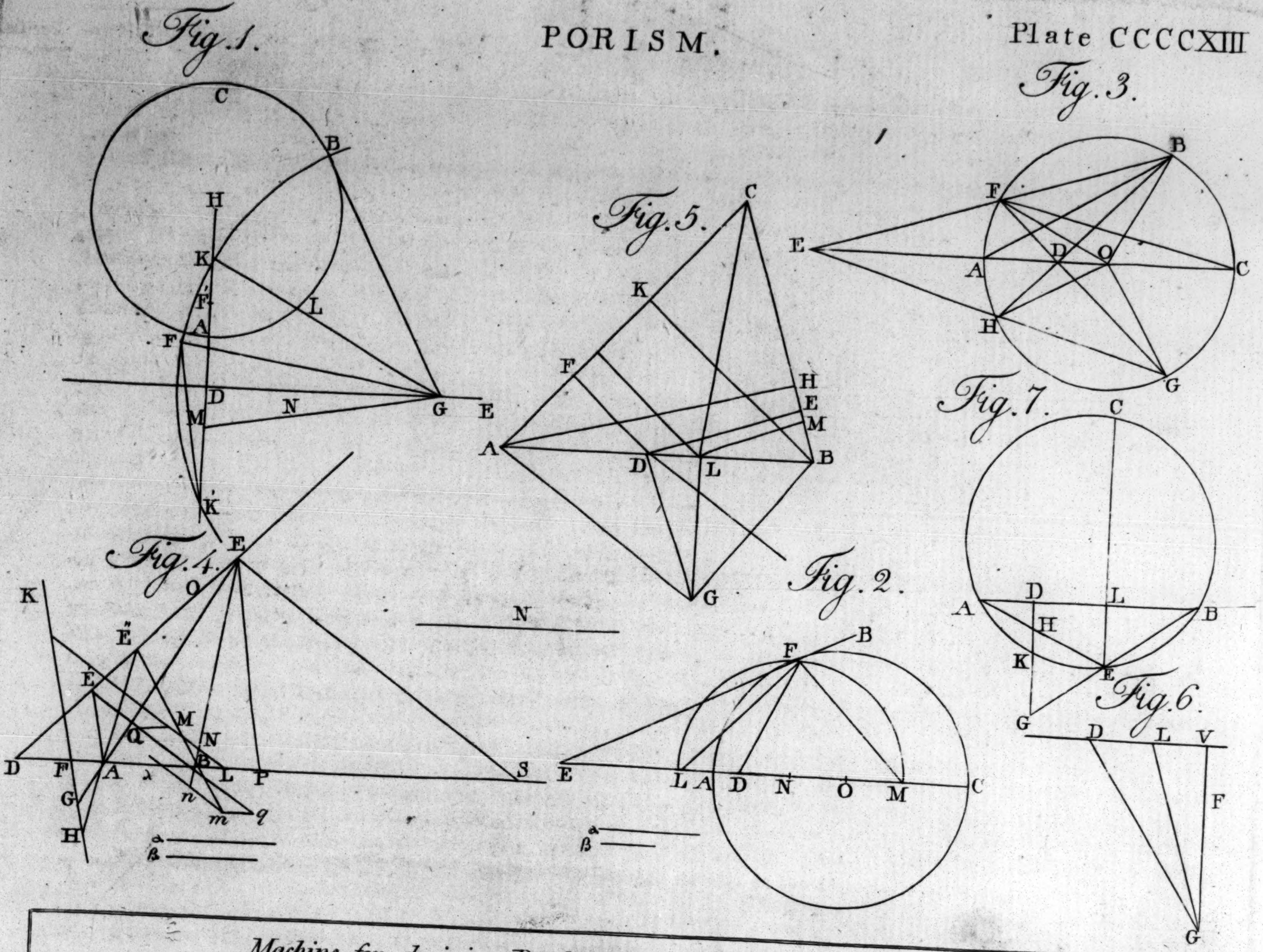
Fig. 1.
C
B
H
K
F
L
A
F
D
N
G
E
M
K
Fig. 3.
B
F
E
D
O
A
C
H
G
Fig. 5.
C
K
F
H
E
M
A
D
L
B
G
Fig. 7.
C
A
D
L
B
H
K
E
G
Fig. 4.
E
O
K
E
E
M
Q
N
D
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A
λ
B
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P
S
G
n
m
q
H
α
β
N
Fig. 2.
F
B
E
L
A
D
N
O
M
C
α
β
Fig. 6.
D
L
V
F
G

Machine for draining Ponds without disturbing the Mud.

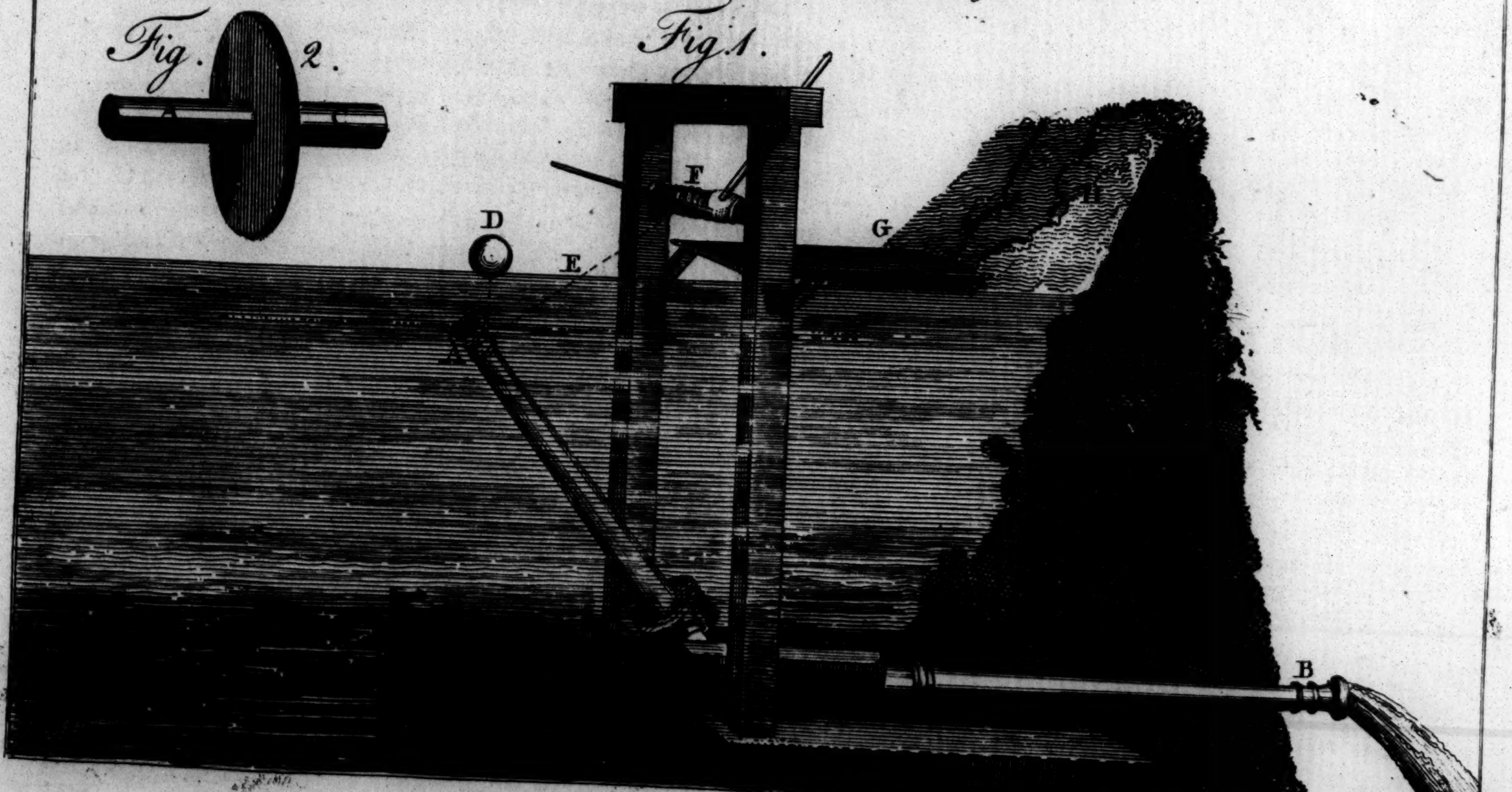
Fig. 2.
Fig. 1.
F
D
E
G
A
B

Trenchard sc.

BRITISH MUSEUM

poſition, and alſo a point R, to find a point D in one of the given lines, ſo that DE and DF being drawn perpendicular to BC, AC, and DR, joined; DE^2+DF^2 may have to DR^2 a given ratio. It is plain, that having found G, the problem would be nothing more than to find D, ſuch that the ratio of GD^2 to DR^2, and therefore that of GD to DR, might be given, the point D being in the circumference of a given circle, as is well known to geometers.

The ſame poriſm alſo aſſiſts in the ſolution of another problem. For if it were required to find D ſuch that DE^2+DF^2 might be a given ſpace; having found G, DG^2 would have to DE^2+DF^2 a given ratio, and DG would therefore be given; whence the ſolution is obvious.

The connection of this poriſm with the impoſſible caſe of the problem is evident; the point L being that from which, if perpendiculars be drawn to AC and CB, the ſum of their ſquares is the leaſt poſſible. For ſince $DF^2+DE^2 : DG^2 :: LO^2+LM^2 : LG^2 ::$ and ſince LG is leſs than DG, LO^2+LM^2 muſt be leſs than DF^2+DE^2. It is evident from what has now appeared, that in ſome inſtances at leaſt there is a cloſe connection between thoſe propoſitions and the *maxima* or *minima*, and of conſequence the impoſſible caſes of problems. The nature of this connection requires to be farther inveſtigated, and is the more intereſting becauſe the tranſition from the indefinite to the impoſſible caſe ſeems to be made with wonderful rapidity. Thus in the firſt propoſition, though there be not properly ſpeaking an impoſſible caſe, but only one where the point to be found goes off *ad infinitum*, it may be remarked, that if the given point F be anywhere out of the line HD (fig. 1), the problem of drawing GB equal to GF is always poſſible, and admits of juſt one ſolution; but if F be in DH, the problem admits of no ſolution at all, the point being then at an infinite diſtance, and therefore impoſſible to be aſſigned. There is, however, this exception, that if the given point be at K in this ſame line, DH is determined by making DK equal to DL. Then every point in the line DE gives a ſolution, and may be taken for the point G. Here therefore the caſe of numberleſs ſolutions, and of no ſolution at all, are as it were *conterminal*, and ſo cloſe to one another, that if the given point be at K the problem is indefinite; but if it remove ever ſo little from K, remaining at the ſame time in the line DH, the problem cannot be reſolved. This affinity might have been determined *à priori*: for it is, as we have ſeen, a general principle, that a problem is converted into a poriſm when one or when two of the conditions of it neceſſarily involve in them ſome one of the reſt. Suppoſe, then, that two of the conditions are exactly in that ſtate which determines the third; then while they remain fixed or given, ſhould that third one vary or differ ever ſo little from the ſtate required by the other two, a contradiction will enſue: therefore if, in the hypotheſis of a problem, the conditions be ſo related to one another as to render it indeterminate, a poriſm is produced; but if, of the conditions thus related to one another, ſome one be ſuppoſed to vary, while the others continue the ſame, an abſurdity follows, and the problem becomes impoſſible. Wherever, therefore, any problem admits both of an indeterminate and an impoſſible caſe, it is certain, that theſe caſes are nearly related to one another, and that ſome of the conditions by which they are produced are common to both." It is ſuppoſed above, that *two* of the conditions of a problem involve in them a third; and wherever that happens, the concluſion which has been deduced will invariably take place. But a poriſm may in ſome caſes be ſo ſimple as to ariſe from the mere coincidence of *one* condition with another, though in no caſe whatever any inconſiſtency can take place between them. There are, however, comparatively few poriſms ſo ſimple in their origin, or that ariſe from problems where the conditions are but little complicated; for it uſually happens that a problem which can become indefinite may alſo become impoſſible; and if ſo, the connection already explained never fails to take place.

Plate CCCCXIII

Another ſpecies of impoſſibility may frequently ariſe from the poriſmatic caſe of a problem which will affect in ſome meaſure the application of geometry to aſtronomy, or any of the ſciences depending on experiment or obſervation. For when a problem is to be reſolved by help of data furniſhed by experiment or obſervation, the firſt thing to be conſidered is, whether the data ſo obtained be ſufficient for determining the thing ſought: and in this a very erroneous judgment may be formed, if we reſt ſatisfied with a general view of the ſubject; for tho' the problem may in general be reſolved from the data with which we are provided, yet theſe data may be ſo related to one another in the caſe under conſideration, that the problem will become indeterminate, and inſtead of one ſolution will admit of an indefinite number. This we have already found to be the caſe in the foregoing propoſitions. Such caſes may not indeed occur in any of the practical applications of geometry; but there is one of the ſame kind which has actually occurred in aſtronomy. Sir Iſaac Newton, in his *Principia*, has conſidered a ſmall part of the orbit of a comet as a ſtraight line deſcribed with an uniform motion. From this hypotheſis, by means of four obſervations made at proper intervals of time, the determination of the path of the comet is reduced to this geometrical problem: Four ſtraight lines being given in poſition, it is required to draw a fifth line acroſs them, ſo as to be cut by them into three parts, having given ratios to one another. Now this problem had been conſtructed by Dr Wallis and Sir Chriſtopher Wren, and alſo in three different ways by Sir Iſaac himſelf in different parts of his works; yet none of theſe geometers obſerved that there was a particular ſituation of the lines in which the problem admitted of innumerable ſolutions: and this happens to be the very caſe in which the problem is applicable to the determination of the comet's path, as was firſt diſcovered by the Abbé Boſcovich, who was led to it by finding, that in this way he could never determine the path of a comet with any degree of certainty.

Beſides the geometrical there is alſo an algebraical analyſis belonging to poriſms; which, however, does not belong to this place, becauſe we give this account of them merely as an article of ancient geometry; and the ancients never employed algebra in their inveſtigations. Mr Playfair, profeſſor of mathematics in the univerſity of Edinburgh, has written a paper on the origin and geometrical inveſtigation of poriſms, which is publiſhed in the third volume of the Tranſactions of the Royal Society of Edinburgh, from which this account of the ſubject is taken. He has there promiſed a ſecond part to his paper, in which the algebraical inveſtigation of poriſms is to be conſidered. This will no doubt throw conſiderable light upon the ſubject, as we may readily judge from that gentleman's known abilities, and from the ſpecimen he has already given us in the firſt part.

PORK, the fleſh of ſwine killed for the purpoſes of food. See Sus.

The hog is the only domeſtic animal that we know of no uſe to man when alive, and therefore ſeems properly deſigned for food. Beſides, as loathſome and ugly to every human eye, it is killed without reluctance. The Pythagoreans, whether to preſerve health, or on account of compaſſion, generally forbade the uſe of animal food; and yet it is alleged that Pythagoras reſerved the uſe of hog's fleſh for himſelf. The Jews, the Egyptians, &c. and other inhabitants of warm countries, and all the Mahometans at preſent, reject the uſe of pork. It is difficult to find a ſatisfactory reaſon for this, or for the precept given to the Jews reſpecting it, though unqueſtionably there was ſome good one for it. The Greeks gave great commendations to this food; and Galen, though indeed that is expected to be from a particular fondneſs, is every where full of it. The Romans conſidered it as one of their delicacies; and if ſome of the inhabitants of the northern climates have taken an averſion to it, that probably aroſe from the uncultivated ſtate of their country not being able to rear it. Pork is of a very tender ſtructure; increaſed perhaps from a peculiarity in its œconomy, viz. taking on fat more readily than any other animal. Pork is a white meat even in its adult ſtate, and then gives out a jelly in very great quantity. On account of its little perſpirability and tenderneſs it is very nutritious, and was given for that intention to the *athletæ*. With regard to its alkaleſcency, no proper experiments have yet been made; but as it is of a gelatinous and ſucculent nature, it is probably leſs ſo than many others. Upon the whole, it appears to be a very valuable nutriment; and the reaſon is not very obvious why it was in ſome countries forbidden. It is ſaid that this animal is apt to be diſeaſed; but why were not inconveniences felt on that account in Greece? Again, it has been alleged, that as Paleſtine would not rear theſe animals, and as the Jews had learned the uſe of them in Egypt, it was neceſſary they ſhould have a precept to avoid them. But the Egyptians themſelves did not uſe this meat; and this religious precept, indeed, as well as many others, ſeems to have been borrowed from them. Poſſibly, as pork is not very perſpirable, it might increaſe the leproſy, which was ſaid to be epidemic in Paleſtine; though this is far from being certain.

Cullen's Mat. Med.

PORLOCK, in the county of Somerſet in England, is a ſmall ſea-port town ſix miles weſt from Minehead. This whole pariſh, including hamlets, contains about 110 houſes, and nearly 600 inhabitants. The ſituation of the town is very romantic, being nearly ſurrounded on all ſides, except toward the ſea, by ſteep and lofty hills, interſected by deep vales and hollow glens. Some of the hills are beautifully wooded, and contain numbers of wild deer. The valleys are very deep and pictureſque; the ſides being ſteep, ſcarred with wild rocks, and patched with woods and foreſt ſhrubs. Some of them are well cultivated and ſtudded with villages or ſingle farms and cottages, although agriculture here is very imperfectly underſtood. Moſt of the roads and fields are ſo ſteep, that no carriages of any kind can be uſed; all the crops are therefore carried in with crooks on horſes, and the manure in wooden pots called *doſſels*. Many of the poor are employed in ſpinning yarn for the Dunſter manufactory. W. Long. 3. 32. N. Lat. 51. 14.

PORO. See Calauria.

PORPESSE, in ichthyology. See Delphinus.

PORPHYRIUS, a famous Platonic philoſopher, was born at Tyre in 233, in the reign of Alexander Severus. He was the diſciple of Longinus, and became the ornament of his ſchool at Athens; from thence he went to Rome, and attended Plotinus, with whom he lived ſix years. After Plotinus's death he taught philoſophy at Rome with great applauſe; and became well ſkilled in polite literature, geography, aſtronomy, and muſic. He lived till the end of the third century, and died in the reign of Diocleſian. There are ſtill extant his book on the Categories of Ariſtotle; a Treatiſe on Abſtinence from Fleſh; and ſeveral other pieces in Greek. He alſo compoſed a large treatiſe againſt the Chriſtian religion, which is loſt. That work was anſwered by Methodius biſhop of Tyre, and alſo by Euſebius, Apollinarius, St Auguſtin, St Jerome, St Cyril, and Theodoret. The emperor Theodoſius the Great cauſed Porphyrius's book to be burned in 338. Thoſe of his works that are ſtill extant were printed at Cambridge in 1655, 8vo, with a Latin verſion.

"Porphyrius (ſays Dr Enfield) was, it muſt be owned, a writer of deep erudition; and had his judgement and integrity been equal to his learning, he would have deſerved a diſtinguiſhed place among the ancients. But neither the ſplendor of his diction, nor the variety of his reading, can atone for the credulity or the diſhoneſty which filled the narrative parts of his works with ſo many extravagant tales, or intereſt the judicious reader in the abſtruſe ſubtelties and myſtical flights of his philoſophical writings."

PORPHYRY, a genus of ſtones belonging to the order of ſaxa. It is found of ſeveral different colours, as green, deep-red, purple, black, dark-brown, and grey. Under the name of *porphyry*, Mr Kirwan and M. de Sauſſure include thoſe ſtones which contain either felt-ſpar, ſchoerl, quartz, or mica, with other ſpecies of cryſtallized ſtone on a ſiliceous or calcareous ground. There are a great many different kinds. M. Ferber deſcribes 20 varieties under four ſpecies, but in general it is conſidered with relation to its ground, which is met with of the colours already mentioned. When the ground is of jaſper, the porphyry is commonly very hard; the red generally contains felt-ſpar in ſmall white dots or ſpecks; and frequently, together with theſe, black ſpots of ſchoerl. The green is often magnetic, and is either a jaſper or ſchoerl, with ſpots of quartz. Sometimes a porphyry of one colour contains a fragment of another of a different colour. Thoſe that have chert for their ground are fuſible *per ſe*. The calcareous porphyry conſiſts of quartz, felt-ſpar, and mica, in ſeparate grains, united by a calcareous cement; and, laſtly, the micaceous porphyry conſiſts of a greeniſh grey micaceous ground, in which red felt-ſpar and greeniſh ſoap-rock are inſerted.

The porphyry of the ancients is a moſt elegant maſs of an extremely firm and compact ſtructure, remarkably heavy, and of a fine ſtrong purple, variegated more or

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leſs with pale red and white; its purple is of all degrees, from the claret-colour to that of the violet; and its variegations are rarely diſpoſed in veins, but ſpots, ſometimes very ſmall, and at others running into large blotches. It is leſs fine than many of the ordinary marbles; but it excels them all in hardneſs, and is capable of a moſt elegant poliſh. It is ſtill found in immenſe ſtrata in Egypt. The hard red-lead coloured porphyry, variegated with black, white, and green, is a moſt beautiful and valuable ſubſtance. It has the hardneſs and all the other characters of the oriental porphyry; and even greatly excels it in brightneſs, and in the beauty and variegation of its colours. It is found in great plenty in the iſland of Minorca; and is well worth importing, being greatly ſuperior to all the Italian marbles. The hard, pale-red porphyry, variegated with black, white, and green is of a pale fleſh-colour; often approaching to white. It is variegated in blotches from half an inch to an inch broad. It takes a high poliſh, and emulates all the qualities of the oriental porphyry. It is found in immenſe ſtrata in Arabia Petræa, and in the Upper Egypt; and in ſeparate nodules in Germany, England, and Ireland.

Ficoroni takes notice of two exquiſitely fine columns of black porphyry in a church at Rome. In Egypt there are three celebrated obeliſks or pillars of porphyry, one near Cairo and two at Alexandria. The French call them *aguglias*, and in England they are called *Cleopatra's needles*.

The art of cutting porphyry, practiſed by the ancients, appears now to be loſt. Indeed it is difficult to conceive what tools they uſed for faſhioning thoſe huge columns and other porphyry works in ſome of the ancient buildings in Rome. One of the moſt conſiderable of theſe, ſtill entire, is a tomb of Conſtantia, the emperor Conſtantine's daughter. It is in the church of St Agnes, and is commonly called *the tomb of Bacchus*. In the palace of the Thuilleries there is alſo a buſt of Apollo and of twelve emperors, all in porphyry. Some ancient pieces ſeem to have been wrought with the chiſſel, others with the ſaw, others with wheels, and others gradually ground down with emery. Yet modern tools will ſcarce touch porphyry. Dr Leiſter therefore thinks*, that the ancients had the ſecret of tempering ſteel better than we; and not, as ſome imagine, that they had the art of ſoftening the porphyry; though it is probable that time and air have contributed to increaſe its hardneſs. Mr Addiſon ſays, he ſaw a workman at Rome cutting porphyry; but his advances were extremely ſlow and almoſt inſenſible. The Italian ſculptors work the pieces of old porphyry columns ſtill remaining (for the porphyry quarries are long ſince loſt) with a braſs ſaw without teeth. With this ſaw, emery, and water, they rub and wear the ſtone with infinite patience. Many perſons have endeavoured to retrieve the ancient art, and particularly Leon Baptiſta Alberti; who, ſearching for the neceſſary materials for temper, ſays, he found goats blood the beſt of any: but even this availed not much; for in working with chiſſels tempered with it, ſparks of fire came much more plentifully than pieces of the ſtone. The ſculptors were thus, however, able to make a flat or oval form; but could never attain to any thing like a figure.

In the year 1555, Coſmo de Medicis is ſaid to have diſtilled a water from certain herbs, with which his ſculptor Franceſco Tadda gave his tools ſuch an admirable hardneſs and ſo fine a temper, that he performed ſome very exquiſite works with them; particularly our Saviour's head in demi-relievo, and Coſmo's head and his ducheſs's. The very hair and beard, how difficult ſoever, are here well conducted; and there is nothing of the kind ſuperior to it in all the works of the ancients; but the ſecret appears to have died with him. The French have diſcovered another mode of cutting porphyry, *viz.* with an iron ſaw without teeth, and *grez*, a kind of free ſtone pulverized, and water. The authors of this invention ſay, that they could form the whole contour of a column hereby if they had matter to work on. Others have propoſed to harden tools ſo as to cut porphyry, by ſteeping them in the juice of the plant called *bear's beech* or *brankurſine*. See Birch's *Hiſt.* R. S. vol. i. p. 238. vol. ii. p. 73, &c. Mr Boyle ſays, that he cauſed porphyry to be cut by means of emery, ſteel ſaws, and water; and obſerves, that in his time the Engliſh workmen were ignorant of the manner of working porphyry, and that none of them would undertake to cut or poliſh it. See his Works abr. vol. i. p. 111.

Da Coſta ſuppoſes, and perhaps with reaſon, that the method uſed by the ancients in cutting and engraving porphyry was extremely ſimple, and that it was performed without the aid of any ſcientific means that are now loſt. He imagines, that, by unwearied diligence, and with numbers of common tools at great expence, they rudely hewed or broke the ſtone into the intended figure, and by continued application reduced them into more regular deſigns; and that they completed the work by poliſhing it with great labour, by the aid of particular hard ſands found in Egypt. And he thinks, that in the porphyry quarries there were layers of grit or looſe diſunited particles, analogous to the porphyry, which they carefully ſought for, and uſed for this work. See *Nat. Hiſt. of Foſſils*, p. 285.

PORPHYRY-Shell, a ſpecies of MUREX.

PORPITES, the HAIR-BUTTON-STONE, in natural hiſtory, a name given by authors to a ſmall ſpecies of foſſil coral; which is uſually of a rounded figure conſiderably flatted, and ſtriated from the centre everyway to the circumference. Theſe are of different ſizes and of different colours, as greyiſh, whitiſh, browniſh, or bluiſh, and are uſually found immerſed in ſtone. See Plate CC.

PORRUM, the LEEK; a ſpecies of plants, belonging to the genus of ALLIUM.

PORT, a harbour, river, or haven, formed either by nature or art to receive and ſhelter ſhipping from the ſtorms and waves of the open ſea.

Artificial ports are thoſe which are either formed by throwing a ſtrong mound or rampire acroſs the harbour's mouth to ſome iſland or rock, or erecting two long barriers, which ſtretch from the land on each ſide like arms or the horns of a creſcent, and nearly incloſe the haven; the former of theſe are called *mole-heads* and the latter *piers*.

PORT, is alſo a name given on ſome occaſions to the larboard or left ſide of the ſhip, as in the following inſtances. Thus it is ſaid, "the ſhip heels to port," *i. e.* ſtoops or inclines to the larboard-ſide. "Top the yard to port!" the order to make the larboard extremity of a yard higher than the other. "Port the helm!" the order to put the helm over to the larboard-ſide of the veſſel. In all theſe ſenſes this phraſe appears intended to prevent any miſtakes happening from the ſimilarity of ſounds in the words *ſtarboard* and *larboard*, particularly when they relate to the helm, where a miſapprehenſion might be attended with very dangerous conſequences.

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* Philoſ. Tranſact. N° 203. or Lowth's Abrid. vol. ii. p. 560.

PORTS, the embraſures or openings in the ſide of a ſhip of war, wherein the artillery is ranged in battery upon the decks above and below.

The ports are formed of a ſufficient extent to point and fire the cannon, without injuring the ſhip's ſide by the recoil; and as it ſerves no end to enlarge them beyond what is neceſſary for that purpoſe, the ſhipwrights have eſtabliſhed certain dimenſions, by which they are cut in proportion to the ſize of the cannon.

The ports are ſhut in at ſea by a ſort of hanging-doors called the *port-lids;* which are faſtened by hinges to their upper edges, ſo as to let down when the cannon are drawn into the ſhip. By this means the water is prevented from entering the lower decks in a turbulent ſea. The lower and upper edges of the ports are always parallel to the deck, ſo that the guns, when levelled in their carriages, are all equally high above the lower extremity of the ports, which is called the *port-cells*.

PORT, is alſo a ſtrong wine brought from Port-a-port, and alſo called *Porto* and *Oporto*.

Port of the Voice, in muſic, the faculty or habit of making the ſhakes, paſſages, and diminutions, in which the beauty of a ſong or piece of muſic conſiſts.

Port-Crayon, a pencil-caſe, which is uſually four or five inches long, and contrived ſo as that the pencil may ſlide up and down. Its inſide is round, and its outſide is ſometimes filed into eight ſides or faces, on which are drawn the ſector-lines; ſometimes it is made round both without-ſide and within, and has its length divided into inches and parts of inches.

Port-Fire, a compoſition for ſetting fire to powder, &c. Port-fires are frequently uſed by artillery people in preference to matches; and they are diſtinguiſhed into wet and dry port-fires. The compoſition of the former is ſaltpetre four, ſulphur one, and mealed powder four. When theſe materials are thoroughly mixed and ſifted, the whole is to be moiſtened with a little linſeed oil, and rubbed between the hands till all the oil is imbibed by the compoſition. The preparation for dry port-fires is ſaltpetre four, ſulphur one, mealed powder two, and antimony one. Theſe compoſitions are driven into ſmall paper caſes, to be uſed whenever neceſſary.

Port-aux-Prune, ſo called by the French, is a country on the coaſt of Africa, to the north of the iſland of Madagaſcar. It is a rich country, and fertile in rice and paſtures; it is inhabited only by the negroes, who are an induſtrious good ſort of people, but very ſuperſtitious. There are no towns, but ſeveral villages, and they have ſome cuſtoms which ſeem to incline to Judaiſm.

Port-Jackſon, in New Holland. See *New Holland*, n° 7, &c.

Port-Royal, a ſea-port town in the iſland of Jamaica. It was once a place of the greateſt riches and importance in the Weſt Indies: but in 1692 it was deſtroyed by an earthquake, in 1702 by fire, in 1722 by an inundation of the ſea, and in 1744 it ſuffered greatly by a hurricane. It is now reduced to three ſtreets, a few lanes, and about 200 houſes. It contains the royal navy-yard for heaving down and refitting the king's ſhips; the navy-hoſpital, and barracks for a regiment of ſoldiers. The fortifications, which are very extenſive, being in excellent order, and having been lately ſtrengthened with many additional works, it may be ſaid to vie in point of ſtrength with any fortreſs in the king's dominions. The harbour is one of the beſt in the world, and 1000 ſhips may ride therein, ſecure from every wind that can blow. It is ſix miles eaſt of Spaniſhtown, and as much by water ſouth-eaſt of Kingſton. W. Long. 76. 40. N. Lat. 18. 0.

Port-Royal, an iſland in North America, on the coaſt of South Carolina, which, with the neighbouring continent, forms one of the moſt commodious harbours in the United States. It is 15 miles in length; and the town on the north ſhore is called *Beaufort*. W. Long. 80. 10. N. Lat. 31. 40.

Port-Royal, the name of two monaſteries of Ciſtertian nuns in the dioceſe of Paris; the one near Chevreuſe, at the diſtance of five leagues from Paris, called *Port-Royal of the Fields;* and the other in Paris, in the ſuburbs of St James.

The nuns of the former of theſe monaſteries proving refractory, were diſperſed; when many eccleſiaſtics, and others, who were of the ſame ſentiments as theſe religious, retired to Port-Royal, took apartments there, and printed many books. Hence the name of *Port-Royaliſts* was given to all their party, and their books were called *books of Port-Royal:* from hence we ſay the writers of Port-Royal, Meſſieurs de Port-Royal, and the tranſlations and grammars of Port-Royal.

PORTA, or *Vena Porta*, in anatomy, a large vein diſtributed through the liver in the manner of an artery. See ANATOMY, n° 96.

Porta-Anguſta (anc. geog.), mentioned only by Ptolemy; a town of the Vaccæi in the Hither Spain; thought by ſome to be *Torre Quemada*, in Old Caſtile; by others *Los Valvaſes*, a village between Burgos and Torre Quemada.

PORTÆ-ROMANÆ (anc. geog.), according to Pliny, Romulus left but three, or at moſt four, gates of Rome: afterwards, on enlarging the Pomœria, or compaſs of the city, they amounted to 37.

PORTAL, in architecture, a little gate where there are two gates of a different bigneſs; alſo a little ſquare corner of a room cut off from the reſt by the wainſcot, and forming a ſhort paſſage into the room. The ſame name is alſo ſometimes given to a kind of arch of joiners work before a door.

PORTATE, or a *Croſs Portate*, in heraldry, a croſs which does not ſtand upright, as croſſes generally do; but lies acroſs the eſcutcheon in bend, as if it were carried on a man's ſhoulder.

PORTCULLICE, in fortification, is an aſſemblage of ſeveral large pieces of wood, joined acroſs one another like a harrow, and each pointed with iron at the bottom. They are ſometimes hung over the gate-way of old fortified towns, ready to let down in caſe of ſurpriſe, when the gates could not be ſhut.

PORTER, a kind of malt-liquor which differs from ale and pale beer, in its being made with high dried malt. See ALE, BEER, and BREWING.

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PORT-GLASGOW. See GLASGOW, n° 10.

PORTGREVE, or PORTGRAVE, was anciently the principal magiſtrate in ports and other maritime towns. The word is formed from the Saxon *port*, "a port or other town;" and *geref*, "a governor."—It is ſometimes alſo written *port-reve*.

Camden obſerves, that the chief magiſtrate of London was anciently called *port-greve*: inſtead of whom, Richard I. ordained two bailiffs; and ſoon afterwards King John granted them a mayor for their yearly magiſtrate.

PORTICI, a palace of the king of Naples, ſix miles from that capital. It has a charming ſituation, on the ſea-ſide, near mount Veſuvius. It is enriched with a vaſt number of fine ſtatues, and other remains of antiquity, taken out of the ruins of Herculaneum.

The muſeum conſiſts of 16 rooms, in which the different articles are arranged with very great taſte. The floors are paved with Moſaic, taken from the recovered towns, and the walls of the court are lined with inſcriptions. Beſides buſts, ſtatues, medals, intaglios, lamps, and tripods, there is ſcarcely an article uſed by the ancients of which a ſpecimen may not be ſeen in this muſeum. "But the moſt valuable room is the library, from the numerous manuſcript rolls which it contains. What a field is here for conjecture! what room for hope! Among this ineſtimable collection, how many great works are there, of which even the names are now unknown! how many unbroken volumes, whoſe very fragments, preſerved in the writings of the ancient ſcholiaſts, convey to us moral improvement, information, and delight! perhaps all the dramatic pieces of Menander and Philemon; perhaps, nay, certainly, the loſt Decades of Livy; for it is impoſſible to ſuppoſe, that among ſo many rolls, the moſt admired hiſtory of the people who poſſeſſed them is not to be found: what private library in Britain is without the beſt hiſtories of England? But how I tremble for their ſituation, as Portici is built on the lava that overwhelmed Herculaneum! How I tremble too for the indifference of the king of Naples towards this invaluable treaſure, in which all the moſt enlightened people of Europe are deeply intereſted! When I firſt ſaw them, I had no idea of what they were, as they reſemble wooden truncheons burnt almoſt to charcoal. They are ſo hard and brittle, that the greateſt caution muſt be uſed in removing them, leſt they crumble to duſt; nevertheleſs, an ingenious friar of Genoa, named *Raggio*, undertook to unroll them; and by a moſt curious, though tedious proceſs, ſo far ſucceeded, as to tranſcribe three Greek Treatiſes on Philoſophy and Muſic; but finding (as I hear) no other encouragement than his ſalary, which was but little more than you pay ſome of your ſervants, the work was unhappily diſcontinued. Were theſe manuſcripts in England, they would not long remain a ſecret to the world."

Watkins's Travels through Swiſſerland, Italy, &c.

PORTICO, in architecture, a kind of gallery on the ground; or a piazza encompaſſed with arches ſupported by columns, where people walk under covert. The roof is uſually vaulted, ſometimes flat. The ancients called it *lacunar*. Though the word *portico* be derived from *porta*, "gate, door;" yet it is applied to any diſpoſition of columns which form a gallery, without any immediate relation to doors or gates. The moſt celebrated porticoes of antiquity were, thoſe of Solomon's temple, which formed the atrium or court, and encompaſſed the ſanctuary; that of Athens, built for the people to divert themſelves in, and wherein the philoſophers held their diſputes and converſations, (ſee PORCH); and that of Pompey at Rome, raiſed merely for magnificence, conſiſting of ſeveral rows of columns ſupporting a platform of vaſt extent; a draught whereof, Serlio gives us in his antique buildings. Among the modern porticoes, the moſt celebrated is the piazza of St Peter of the Vatican.—That of Covent-Garden, London, the work of Inigo Jones, is alſo much admired.

PORTII. See POMPEII.

PORTLAND, a peninſula in Dorſetſhire, of great ſtrength both by nature and art, being ſurrounded with inacceſſible rocks, except at the landing-place, where there is a ſtrong caſtle, called *Portland caſtle*, built by king Henry VIII. There is but one church in the iſland: and that ſtands ſo near the ſea, that it is often in danger from it. It is now chiefly noted for the freeſtone which is found there, and which is greatly employed in London, and other parts of England, for building the fineſt ſtructures. St Paul's church, in particular, was built therewith. W. Long. 2. 35. N. Lat. 50. 30.

The following cuſtom at Portland is worthy of notice. "While I was looking over the quarries at Portland (ſays Mr Smeaton), and attentively conſidering the operations, obſerving how ſoon the quarrymen would cut half a ton of ſpawls from an unformed block, and what large pieces flew off at every ſtroke; how ſpeedily their blows followed one another, and how inceſſantly they purſued this labour with a tool of from 18 to 20 pound weight; I was naturally led to view and conſider the figure of the operative agent; and after having obſerved, that by far the greateſt number of the quarrymen were of a very robuſt hardy form, in whoſe hands the tool I have mentioned ſeemed a mere play-thing, I at laſt broke out with ſurpriſe, and inquired of my guide, Mr Roper, where they could poſſibly pick up ſuch a ſet of ſtout fellows to handle the *kevel*, which in their hands ſeemed nothing? for I obſerved, that in the ſpace of 15 minutes, they would knock off as much waſte matter from a maſs of ſtone, as any of that occupation I had ever ſeen before would do in an hour. Says Roper, 'we do not go to fetch thoſe men from a diſtance, they are all born upon the iſland, and many of them have never been farther upon the main land than to Weymouth.' I told him, I thought the air of that iſland muſt be very propitious, to furniſh a breed of men ſo particularly formed for the buſineſs they followed. 'The air (he replied), though very ſharp from our elevated ſituation, is certainly very healthy to working men; yet if you knew how theſe men are produced, you would wonder the leſs; for all our marriages here are productive of children.' On deſiring an explanation how this happened, he proceeded: 'Our people here, as they are bred to hard larbour, are very early in a condition to marry and provide for a family; they intermarry with one another, very rarely going to the main-land to ſeek a wife; and it has been the cuſtom of the iſland, from time immemorial, that they never marry till the woman is pregnant.' But pray (ſaid I) does not this ſubject you to a great number of baſtards? Have not your Portlanders the ſame kind of fickleneſs in their attachments that Engliſhmen are ſubject to? and, in conſequence, does not this produce many inconveniences? 'None at all (replies Roper), for previous to my arrival here, there was but one child on record of the pariſh regiſter that had been born a baſtard in the compaſs of 150 years. The mode of courtſhip here is, that a young woman never admits of the ſerious addreſſes of a young man, but on ſuppoſition of a thorough probation. When ſhe becomes with child, ſhe tells her mother, the mother tells her father, her father tells his father, and he tells his ſon, that it is then proper time to be married.' But ſuppoſe, Mr Roper, ſhe does not prove to be with child, what happens then? Do they live together without marriage? or, if they ſeparate, is not this ſuch an imputation upon her, as to prevent her getting another ſuitor? 'The caſe is thus managed (anſwered my friend), if the woman does not prove with child after a competent time of courtſhip, they conclude they are not deſtined by Providence for each other; they therefore ſeparate; and as it is an eſtabliſhed maxim, which the Portland women obſerve with great ſtrictneſs, never to admit a plurality of lovers at one time, their honour is no way tarniſhed: ſhe juſt as ſoon (after the affair is declared to be broke off) gets another ſuitor, as if ſhe had been left a widow, or that nothing had ever happened, but that ſhe had remained an immaculate virgin.' But pray, Sir, did nothing particular happen upon your men coming down from London? 'Yes (ſays he) our men were much ſtruck, and mightily pleaſed with the facility of the Portland ladies, and it was not long before ſeveral of the women proved with child; but the men being called upon to marry them, this part of the leſſon they were uninſtructed in; and on their refuſal, the Portland women aroſe to ſtone them out of the iſland; inſomuch, that thoſe few who did not chooſe to take their ſweethearts for *better or for worſe*, after ſo fair a trial, were in reality obliged to decamp; and on this occaſion ſome few baſtards were born: but ſince then matters have gone on according to the ancient cuſtom."

PORTLAND VASE, a celebrated funeral vaſe which was long in poſſeſſion of the Baberini family; but which was lately purchaſed for 1000 guineas by the Duke of Portland, from whom it has derived its preſent name. Its height is about ten inches, and its diameter where broadeſt ſix. There are a variety of figures upon it of moſt exquiſite workmanſhip, in bas relief of white opake glaſs, raiſed on a ground of deep blue glaſs, which appears black except when held againſt the light. It appears to have been the work of many years, and there are antiquarians who date its production ſeveral centuries before the Chriſtian era; ſince, as has been ſaid, ſculpture was declining in excellence in the time of Alexander the Great.

Reſpecting the purpoſe of this vaſe, and what the figures on it were meant to repreſent, there have been a variety of conjectures, which it is not our buſineſs to enumerate. We think with Dr Darwin * that it was not made for the aſhes of any particular perſon deceaſed; and therefore that the ſubject of its embelliſhments is not a private hiſtory, but of a general nature. But we are not ſure that he is right in conjecturing it to repreſent a part of the Eleuſinian myſteries; becauſe that conjecture depends on Warburton's explanation of the 6th book of the Æneid, which does not now command that reſpect which it did when it was firſt propoſed. We ſhall therefore give a ſhort account of the ſeveral figures, without noticing any of the theories or conjectures that have been made about them.

In one compartment three exquiſite figures are placed on a ruined column, the capital of which is fallen, and lies at their feet among other disjointed ſtones: they ſit under a tree on looſe piles of ſtone. The middle figure is a female in a reclining and dying attitude, with an inverted torch in her left hand, the elbow of which ſupports her as ſhe ſinks, while the right hand is raiſed and thrown over her drooping head. The figure on her right hand is a man, and that on the left a woman, both ſupporting themſelves on their arms, and apparently thinking intenſely. Their backs are to the dying figure, and their faces are turned to her, but without an attempt to aſſiſt her. On another compartment of the vaſe is a figure coming through a portal, and going down with great timidity into a darker region, where he is received by a beautiful female, who ſtretches forth her hand to help him: between her knees is a large and playful ſerpent. She ſits with her feet towards an aged figure, having one foot ſunk into the earth, and the other raiſed on a column, with his chin reſting on his hand. Above the female figure is a Cupid preceding the firſt figure, and beckoning to him to advance. This firſt figure holds a cloke or garment, which he ſeems anxious to bring with him, but which adheres to the ſide of the portal through which he has paſſed. In this compartment there are two trees, one of which bends over the female figure and the other over the aged one. On the bottom of the vaſe there is another figure on a larger ſcale than the one we have already mentioned, but not ſo well finiſhed nor ſo elevated. This figure points with its finger to its mouth. The dreſs appears to be curious and cumberſome, and above there is the foliage of a tree. On the head of the figure there is a Phrygian cap: it is not eaſy to ſay whether this figure be male or female. On the handles of the vaſe are repreſented two aged heads with the ears of a quadruped, and from the middle of the forehead riſes a kind of tree without leaves: theſe figures are in all probability mere ornaments, and have no connection with the reſt of the figures, or the ſtory repreſented on the vaſe.

PORTLANDIA, in botany: A genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking with thoſe of which the order is doubtful. The corolla is elevated and funnel-ſhaped; the antheræ are longitudinal; the capſule pentagonal, and retuſe at top; bilocular, and crowned with a pentaphyllous calyx.

There are two ſpecies, viz. the grandiflora and hexandra; the former of which has been particularly deſcribed by Dr Browne, who has alſo given a good figure of it. It has frequently flowered in the royal garden at Kew, and in Dr Pitcairn's at Iſlington.

The external bark is remarkably rough, furrowed, and thick; it has no taſte. The inner bark is very thin, and of a dark brown colour. Its taſte is bitter and aſtringent, and its virtues are the ſame as thoſe of the Jeſuit's bark. Infuſed in ſpirits or wine with a little orange-peel, it makes an excellent ſtomachic tincture.

PORT-LOUIS, is a ſtrong town of France, in Bretagne,

* Loves of the Plants.

tagne, in the dioceſe of Vannes, with a citadel and a good harbour. It was fortified by Louis XIII. from whom it derived its name. It was a ſtation for part of the royal navy and the Eaſt India ſhips belonging to France. It is ſeated at the mouth of the river Blavet, 27 miles weſt of Vannes. W. Long. 3. 18. N. Lat. 47. 40.

Port-Mahon. See MINORCA.

PORTO. See OPORTO.

Porto-Bello, a town of North America, ſituated in N. Lat. 9. 3. W. Long. 79. 45. cloſe to the ſea, on the declivity of a mountain, which ſurrounds the whole harbour. This harbour is ſo large, deep, and ſafe, that Columbus, who firſt diſcovered it, gave it the name of *Porto-Bello*, or the "Fine Harbour," which is now commonly uſed to denote the town. The number of the houſes is about 130; moſt of them of wood, large and ſpacious, forming one long ſtreet along the ſtrand, with other ſmaller ones croſſing it. The governor of the town is always a gentleman of the army, ſubordinate to the preſident of Panama; but having under him the commandants of the forts that defend the harbour. At the eaſt end of the town, on the road to Panama, is a place called *Guinea*, where all the negroes of both ſexes, whether ſlaves or free, have their habitations. This place is very much crowded when the galleons are here, moſt of the inhabitants of the town quitting their houſes entirely for the ſake of letting them; while others content themſelves with a ſmall part, in order to make money of the reſt. The Mulattoes and other poor families alſo remove either to Guinea, or to cottages already erected near it, or built on the occaſion. Great numbers of artificers likewiſe who flock to Porto-Bello from Panama to work at their reſpective callings during the fair, lodge in Guinea for cheapneſs. Towards the ſea, in a large tract between the town and Gloria caſtle, barracks are erected, in moſt of which the ſhips crews keep ſtalls of ſweetmeats, and other kinds of eatables, brought from Spain; but at the concluſion of the fair, when the ſhips put to ſea, all theſe buildings are taken down, and the town returns to its former tranquillity and emptineſs. In 1739, the harbour was defended by a caſtle and two forts; which were all demoliſhed by admiral Vernon, who, with ſix ſhips only, made himſelf maſter of this port. The country about Porto-Bello is over-run with mountains and impenetrable foreſts, except a few valleys, in which are ſome ſcattered farms. Among the mountains that ſurround the harbour is one diſtinguiſhed by the name of *Capiro*, and by its ſuperior loftineſs is a ſort of barometer to the country, by foretelling every change of weather. Its top is always covered with clouds, of a denſity and darkneſs ſeldom ſeen in thoſe of the atmoſphere. When theſe clouds thicken, increaſe their blackneſs, and ſink below their uſual ſtation, it is a ſure ſign of a tempeſt; while, on the other hand, their clearneſs and aſcent as certainly indicate the approach of fair weather. Theſe changes are very ſudden and frequent here. The ſummit of the mountain is ſcarce ever clear from clouds; and when it happens, it is only, as it were, for an inſtant. Except in the time of the fair, all the inhabitants of Porto-Bello do not amount to 3000; half of whom are Indians, Mulattoes, or Negroes; the Spaniards of any ſubſtance not chooſing to reſide in a place ſo extremely unhealthy and fatal even to the lives of the natives. Ulloa tells us, that the cattle brought hither from Panama or Carthagena, loſe their fleſh ſo faſt in the beſt paſtures, as to become ſcarce eatable: he aſſures us alſo, that neither horſes nor aſſes are bred here. The heat, indeed, is exceſſive; and the torrents of rain are ſo dreadful, ſudden, and impetuous, that one not accuſtomed to them would imagine a ſecond deluge was coming. Theſe torrents are alſo accompanied with frightful tempeſts of thunder and lightning, the awfulneſs of the ſcene being heightened by the repercuſſions from the mountains, and the ſhrieks and howlings of multitudes of monkeys of all kinds which inhabit the ſurrounding woods.

Freſh water pours down in ſtreams from the mountains, ſome running without the town, and others croſſing it. Theſe waters are very light and digeſtive; qualities which in other countries would be very valuable, but are here pernicious, producing dyſenteries, which the patient ſeldom ſurvives. However, theſe rivulets, formed into reſervoirs, ſerve the purpoſes of bathing, which is here found to be very conducive to health.

As the foreſts almoſt border on the houſes of the ſtreets, tygers often make incurſions into the ſtreets during the night, carrying off fowls, dogs, and other domeſtic animals, and ſometimes even children have fallen a prey to them. Beſides the ſnares uſually laid for them, the Negroes and Mulattoes, who fell wood in the foreſts of the mountains, are very dexterous in encountering them; and ſome, for a ſlender reward, even ſeek them in their retreats.

The town of Porto-Bello, which is thinly inhabited by reaſon of its noxious air, the ſcarcity of proviſions, and the barrenneſs of the ſoil, becomes, after the arrival of the galleons, one of the moſt populous towns in the world. He who had ſeen it quite empty, and every place wearing a melancholy aſpect, would be filled with aſtoniſhment to ſee the buſtling multitudes in the time of the fair, when every houſe is crowded, the ſquares and ſtreets encumbered with bales of merchandiſe and cheſts of gold and ſilver, the harbour full of ſhips and veſſels, ſome loaded with proviſions from Carthagena, and others with the goods of Peru, as cocoa, Jeſuit's bark, Vicuna wool, and bezoar ſtones; and this town, at all other times deteſted for its deleterious qualities, becomes the ſtaple of the riches of the Old and New World, and the ſcene of one of the moſt conſiderable branches of trade in the univerſe. Formerly the fair was limited to no particular time; but as a long ſtay in ſuch a ſickly place extremely affected the health of the traders, his Catholic majeſty tranſmitted an order that the fair ſhould not laſt above 40 days; and that, if in that time the merchants could not agree on their rates, thoſe of Spain ſhould be allowed to carry their goods up the country to Peru: and accordingly, the commodore of the galleons has orders to re-embark them, and return to Carthagena; but otherwiſe, by virtue of a compact between the merchants of both kingdoms, and ratified by the king, no Spaniſh trader is to ſend his goods, on his own account, beyond Porto-Bello. The Engliſh were formerly allowed to ſend a ſhip annually to this fair, which turned ed to great account; and, whilſt the aſſiento contract ſubſiſted, either with the Engliſh or the French, one of their principal factories was at Porto-Bello.

Porto-Farina, a port about 12 miles from Cape Carthage, in the bay of Tunis, where formerly the large veſſels belonging to the bey were fitted out, and laid up on their return from a cruize. This harbour is ſafe from the weather, and opens into a large lake, formed by the Mejerdah, which runs through into the ſea.—The north-weſt wind, which blows right upon the ſhore, together with the ſoil brought down by the river, which has the ſame quality as the Nile of overflowing its banks, has formed a bar, ſo that only ſmall veſſels can now enter. It is ſtill the arſenal where the naval ſtores are kept. E. Long. 10. 16. N. Lat. 37. 12.

Porto-Farraio, a handſome town of Italy, in the iſle of Elba, with a good citadel. It is very ſtrong, and ſeated on a long, high, ſteep point of land, to the weſt of the bay of the ſame name, which has two forts. It belongs to the great duke of Tuſcany, who always keeps a good garriſon there. E. Long. 10. 37. N. Lat. 48. 55.

Porto-Longone, a ſmall but very ſtrong town of Italy, and in the iſle of Elba, with a good harbour, and a fortreſs upon a rock almoſt inacceſſible. The king of Naples has a right to put a garriſon therein, though the place belongs to the prnce of Piombino. It is ſeated on the eaſt end of the iſland, eight miles ſouth-weſt of Piombino. E. Long. 10. 10. N. Lat. 42. 52.

Porto-Santo, an iſland of the Atlantic Ocean, on the coaſt of Africa, and the leaſt of thoſe called the *Madeiras*. It is about 15 miles in circumference, and produces but little corn; however, there are oxen and wild hogs, and a vaſt number of rabbits. There are trees which produce the gum or reſin called *dragon's blood*; and there is likewiſe a little honey and wax, which are extremely good. It has no harbour, but good mooring in the road. It belongs to the Portugueſe, and is 300 miles weſt of the coaſt of Africa. W. Long. 16. 20. N. Lat. 32. 58.

Porto-Seguro, a government of South America, on the eaſtern coaſt of Braſil; bounded on the north by the government of Rio-dos-Hilios, on the eaſt by the North Sea, on the ſouth by the government of Spiritu-Santo, and on the weſt by the Tupicks. It is a very fertile country, and the capital town is of the ſame name. It is built on the top of a rock, at the mouth of a river, on the coaſt of the North Sea, and is inhabited by Portugueſe. W. Long. 38. 50. S. Lat. 17. 0.

Porto-Vechio, is a ſea-port town of Corſica, in the Mediterranean Sea, ſeated on a bay on the eaſtern coaſt of the iſland. It is 12 miles from Bonifacio, and 40 north of Sardinia. E. Long. 9. 20. N. Lat. 41. 42.

Porto-Venereo, is a town of Italy, on the coaſt of Genoa, at the entrance of the gulph of Spetia. It is ſeated on the ſide of a hill, at the top of which there is a fort. It has a very good harbour, and is 45 miles ſouth-eaſt of Genoa. E. Long. 9. 38. N. Lat. 44. 5.

PORTRAIT, or Portraiture, in painting, the repreſentation of a perſon, and eſpecially of a face, done from the life. In this ſenſe we uſe the term *portrait-painting*, in contradiſtinction to *hiſtory-painting*, where a reſemblance of perſons is uſually diſregarded. Portraits, when as large as the life, are uſually painted in oil-colours; ſometimes they are painted in miniature with water-colours, crayons, paſtils, &c. See Painting, p. 641.

PORTREE, is a ſmall village, containing a church and a very few houſes, with an excellent bay and a good harbour, in the Iſle of Sky. "The entrance of the bay (Mr Knox tells us) repreſents agreeable landſcapes on both ſides, with excellent paſture.

Knox's Tour.

'The bay of Portree (ſays Mackenzie), off the houſes, is an exceeding good harbour for a few ſhips of any ſize; it is well ſheltered, the ground good, the depth from five to 14 fathoms, and nothing to fear coming in but a rock, about half a cable's length from Airderachig Point, on the ſtarboard as you enter the anchorage, part of which is always above water.' It is the only port or harbour to a very conſiderable diviſion of Sky, on the eaſt ſide. From this opening to the northern extremity, a courſe of 20 miles, the ſhore is one continued line of lofty rocks, where no ſhip can find refuge in the mildeſt weather, and where inevitable danger await the mariners in rough weather.

"James V. of Scotland and ſeveral of his nobility landed here, when they made the tour of the Hebrides in 1535; from which circumſtance, this fine bay has got the honourable name of *Portree*."

Mr Knox tells us, "that the country round this village, though mountainous, is well inhabited; it raiſes much grain, and many cattle. Here the late Sir James Macdonald had marked out the lines of a town; and government, it is ſaid, promiſed to aſſiſt him in the work with 500 l.; but the death of that gentleman put an end to theſe promiſing appearances, and matters remain in *ſtatu quo*."

PORTSMOUTH, a ſea-port town in Hampſhire, with one of the moſt ſecure and capacious harbours in England, being defended by a numerous artillery, both on the ſea and land-ſide, and very good fortifications. A great part of the royal navy is built here; and here are ſome of the fineſt docks, yards, and magazines of naval ſtores, in Europe. It is ſeated in the iſle of Portſey, being ſurrounded by the ſea except on the north ſide, where there is a river which runs from one arm of it to the other. It is much reſorted to on account of the royal navy, whoſe uſual rendezvous is at Spithead, which is at the eaſt end of the iſle of Wight, and oppoſite to Portſmouth. There is a draw-bridge over the river, and it has always a good garriſon. It is governed by a mayor, 12 aldermen, and burgeſſes, and ſends two members to parliament. It has one church, and two chapels, one in the garriſon, and one in the Common, for the uſe of the dock, and others, beſides ſeveral meeting-houſes of the diſſenters. The houſes of Portſmouth amount to about 2000, and the inhabitants to about 12,000. W. Long. 1. 1. N. Lat. 50. 47.

The town is ſuppoſed to receive its name from Port, a famous Saxon chieftain, who, A. D. 501. landed here with his two ſons. It made a conſiderable figure in the time of the Saxons; and from the utility of its ſituation, was highly favoured by all the monarchs of the Norman line. It was incorporated, and became alſo a parliamentary borough. In the reign of Edward III. it was in a very flouriſhing ſtate; but, A. D. 1338, in the very ſame reign, was burned by the French,

when

Cambell's Political Survey.

when that monarch, which was afterwards ratified by king Richard II. forgave the inhabitants a debt, and remitted their fee-farm for 10 years: within which ſpace they ſo recovered themſelves, as to equip a ſquadron, which ſailed into the mouth of the Seine, ſunk two ſhips, and brought away a great booty. The ſingular excellence of its port, and the convenience of fitting out fleets from thence in the time of a French war, induced Edward IV. to think of fortifying it, as he actually, in ſome meaſure, did; which fortifications were farther carried on by Richard III. But king Henry VII. was the firſt who ſettled a garriſon therein; which was increaſed, and the place made ſtill ſtronger, in the reign of Henry VIII. who had a great dock there, wherein was built the Henry Grace de Dieu, which was the largeſt ſhip in the navy of his time. The ſame monarch, remarkably attentive to the ſecurity of all maritime places, built what is now called *South-Sea caſtle*, for the protection of this.—The improvements made here in the reign of Q. Elizabeth were much ſuperior to all theſe. King Charles II. after his reſtoration, directed great alterations, eſtabliſhed new docks and yards, raiſed ſeveral forts, and fortified them after the modern manner; which works were augmented under his brother's reign. Notwithſtanding this, king William directed likewiſe freſh alterations and additions; and ſucceeding princes, following his example, have, at a large expence, extended theſe fortifications, and taken in a vaſt deal of ground: ſo that it is at preſent, as the importance of the place deſerves, the moſt regular fortreſs in Britain; and, as it cannot be effectually attacked by ſea, may be juſtly eſteemed impregnable.

PORTSMOUTH, the largeſt town in the ſtate of New Hampſhire in North America. It ſtands on the ſouth-eaſt ſide of Piſcataqua river, about two miles from the ſea, and contains about 600 houſes, and 4400 inhabitants. The town is handſomely built, and pleaſantly ſituated. Its public buildings are, a court houſe, two churches for Congregationaliſts, one for Epiſcopalians, and one other houſe for public worſhip. Its harbour is one of the fineſt on the continent, having a ſufficient depth of water for veſſels of any burthen. It is defended againſt ſtorms by the adjacent land, in ſuch a manner, as that ſhips may ſecurely ride there in any ſeaſon of the year. Beſides, the harbour is ſo well fortified by nature, that very little art will be neceſſary to render it impregnable. Its vicinity to the ſea renders it very convenient for naval trade. A light-houſe, with a ſingle light, ſtands at the entrance of the harbour.

PORTSOY, is a handſome ſea-port town, ſituated on a ſmall promontory running into the ſea, on the ſouth ſide of the Murray Frith, in Scotland, about ſix miles from Cullen, and ſeven weſt from Banff. It ſends out ſeveral fiſhing veſſels, particularly for the Hebride white fiſhery, and exports a conſiderable quantity of grain. A manufacture of ſtocking and ſewing thread is alſo carried on to a conſiderable amount for the London and Nottingham markets. In the neighbourhood is a ſtratum of marble, of a dark greeniſh colour, in which, it is ſaid, the curious ſubſtance called ASBESTOS, or earth-flax, has been found. From the aſbeſtos a ſort of incombuſtible cloth is made, which is purified by throwing it into the fire. W. Long. 2. 5. N. Lat. 57. 50.

PORTUGAL, the moſt weſterly kingdom of Europe, bounded on the weſt and ſouth by the Atlantic Ocean, and on the eaſt and north by Spain; extending about 310 miles in length, and 150 in breadth.

Portugal.

See Map of Spain and Portugal.

1
Boundaries

By modern writers, we find this country conſtantly ſtyled in Latin *Luſitania;* and it is certain, that anciently a country of Spain went by that name; but it does not by any means appear that the country called by the ancients *Luſitania* had the ſame boundaries with the modern kingdom of Portugal. Before Auguſtus Cæſar, Luſitania ſeems to have been bounded on the north by the ocean, and on the ſouth by the river Tagus; by which means it comprehended all Galicia, and excluded two of the ſix provinces of Portugal. But in the more ſtrict and reſtrained ſenſe of the word, it was bounded on the north by the Durius, now the Douro, and on the ſouth by the river Anas, now the Guadiana; in which ſenſe it was not quite ſo long as modern Portugal, but conſiderably broader.

2
Etymology of the name.

The commonly received opinion with regard to the etymology of the word *Portugal*, is, that a great number of Gauls landed at Porto, or Oporto, whence it received the name of *Portus Gallorum*, or *the Port of the Gauls;* and in proceſs of time that name gradually extended over the whole country, being ſoftened, or rather ſhortened, into *Portugal.* But the time when this event happened, the reaſon why theſe Gauls came thither, and what became of them afterwards, are all particulars which lie buried in oblivion. It is alleged, however, that, upon an eminence which overlooks the mouth of the river Douro, there ſtood an ancient town called *Cale*, ſtrong and well peopled, but ill ſeated for trade; and this occaſioned the conſtruction of a lower town or hamlet, which was called *Portus Cale*, that is, *the haven of Cale;* and, in proceſs of time, *Portucalia.* At length, becoming ſo conſiderable as to merit an epiſcopal chair, the biſhops ſubſcribed themſelves, as the records of ancient councils teſtify, *Portucalenſes*, and the name of the city was transferred to the dioceſe. It is true, that theſe biſhops afterwards changed their title, and ſubſcribed themſelves *Portuenſes*, that is, *biſhops of Porto.* But the facts juſt mentioned are actually recorded in authentic hiſtories; and as the dioceſe of Portucalia contained in a great meaſure that little country in which the ſovereignty originally began, the name extended itſelf, together with the acquiſitions of the ſovereigns, and has remained to the kingdom, though the dioceſe itſelf has changed its name, and poſſibly on that very account.

3
Originally only a ſmall kingdom.

Portugal, though even yet but a ſmall kingdom, was originally much ſmaller. The Spaniſh and Portugueſe hiſtorians agree, that Don Alonſo, king of Leon and Caſtile, and ſon to Don Ferdinand the Great, beſtowed his daughter Donna Thereſa in marriage upon an illuſtrious ſtranger, Don Henry, and gave him with her the frontier province which he had conquered from the Moors, ſmall indeed in extent, but excellently ſituated, and ſo pleaſant and fertile, that it has ſometimes been ſtyled *Medulla Hiſpanica*, or *the marrow of Spain.* To this territory was added the title of *Count;* but authors are much divided about the time that this ſtranger came into Spain, and who he was. However, the authors of the Univerſal Hiſtory make it pretty evident, that he was a grandſon of Robert the firſt duke of Burgundy. The manner in which he obtained the principality above-mentioned is related as follows:

4
Henry of Burgundy the firſt count of Portugal.

The king, Don Alonſo, apprehenſive that his ſucceſs in taking the city of Toledo would bring upon him the whole force of the Moors, ſent to demand aſſiſtance from Philip I. of France, and the duke of Burgundy, whoſe daughter he had married. His requeſt was granted by both princes; and a numerous body of troops was ſpeedily collected for his ſervice, at whoſe head went Raymond count of Burgundy, Henry younger brother of Hugh duke of Burgundy, Raymond count of Tholouſe, and many others. They arrived at the court of Don Alonſo in the year 1087, where they were received and treated with all poſſible marks of eſteem; and having in the courſe of two or three years given great proofs of their courage and conduct, the king reſolved to beſtow his only daughter named *Urraca*, then a mere child, being at moſt in her ninth year, upon Raymond count of Burgundy, and aſſigned them the province of Galicia for the ſupport of their dignity. About four years after, Don Alonſo being very deſirous to expreſs his gratitude to Henry of Burgundy, gave him in marriage a natural daughter of his, born while he remained in exile at Toledo, whoſe name was *Donna Thereſa;* and upon this marriage, he gave up in full property the country which has been already mentioned.

The new ſovereign, with his conſort, fixed their reſidence in the town of Guimaraez, pleaſantly ſituated on the banks of the river Ave. The remains of an ancient palace belonging to their ſucceſſors are ſtill to be ſeen; and on account of its having been anciently the capital, the king, Don Denis, granted the inhabitants an immunity from taxes, which they ſtill enjoy.

5
Differences with Caſtile.

The Portugueſe, now finding themſelves independent, immediately began, like other nations, to attempt the ſubjection of their neighbours. Henry is ſaid to have performed great exploits againſt the Moors; but the accounts of them are ſo indiſtinct, that they cannot be taken notice of here. He died in 1112; and was ſucceeded by his ſon Don Alonſo, then an infant in the third year of his age. In his minority, the kingdom was governed by his mother Donna Thereſa, aſſiſted by two able miniſters. During the firſt nine years of their adminiſtration, nothing remarkable happened; but after that period, ſome differences took place between the queen regent (for ſhe had aſſumed the title of queen after her father's death) and Urraca queen of Caſtile. Thereſa inſiſted, that ſome part of Galicia belonged to her in virtue of her father's will; and therefore ſeized on Tuy, an epiſcopal town, and a place of ſome conſequence. Urraca, having aſſembled a numerous army, went in perſon into Galicia; upon which Thereſa was obliged to abandon Tuy, and take ſhelter in one of her own fortreſſes. The conſequences, in all probability, would have been fatal to the new kingdom, had not the archbiſhop of Compoſtella, without whoſe aſſiſtance Urraca could do nothing, demanded leave to retire with his vaſſals. This offended the queen to ſuch a degree, that ſhe threw him into priſon; which act of violence excited ſuch a commotion among her own ſubjects, that the Portugueſe were ſoon delivered from their apprehenſions. Queen Thereſa fell immediately after into a ſimilar error, by throwing into priſon the archbiſhop of Braga, who had not eſpouſed her cauſe ſo warmly as ſhe had expected. The biſhop, however, was quickly delivered by a bull from the pope, who alſo threatened the kingdom with an interdict; and this was the firſt remarkable offence which Thereſa gave her ſubjects.

Soon after this, Queen Urraca died, and all differences were amicably ſettled at an interview between Thereſa and Don Alonſo Raymond, who ſucceeded to the kingdom of Caſtile. But, in 1126, the king of Caſtile being obliged to march with the whole ſtrength of his dominions againſt his father-in-law the king of Navarre and Arragon, Thereſa took the opportunity of again ſeizing upon Tuy; but the king ſoon returning with a ſuperior army, ſhe was again obliged to abandon her conqueſt. But the greateſt misfortune which befel this princeſs, was a quarrel with her own ſon Don Alonſo Enriquez. It does not appear indeed that Thereſa had given him any juſt cauſe of offence; but it is certain that a civil war enſued, in which the queen's forces were totally defeated, and ſhe herſelf made priſoner, in which ſituation ſhe continued during the remainder of her life.

6
Don Alonſo's wars with the Moors and king of Caſtile.

Enriquez having thus attained to the free and full poſſeſſion of his dominions, made ſeveral attempts upon ſome places in Galicia, but without ſucceſs; ſo that he was at laſt conſtrained to make peace with Alonſo king of Caſtile and Leon, who had aſſumed the title of *Emperor of the Spains;* the more eſpecially as his dominions happened to be at that time invaded by the Moors.—The number of infidels was ſo great, that the count of Portugal had little hopes of ſubduing them; but a plague breaking out in the Mooriſh army, they were obliged to retreat; after which he reduced ſeveral places belonging to that nation. But, in the mean time, the emperor Don Alonſo, breaking into the Portugueſe territories, deſtroyed every thing with fire and ſword. The king of Portugal ſurpriſed and cut off a conſiderable part of his army; which, however, did not hinder the emperor from marching directly towards him.—But, at the interceſſion of the pope's legate, all differences were accommodated, and a peace concluded; all places and priſoners taken on both ſides being delivered up.

7
Victory of Ourique.

In the mean time, the progreſs of the Chriſtian arms in Spain being reported to Abu-Ali Texefien, the miramamolin or chief monarch of the Moors in Barbary, he directed Iſmar, or Iſhmael, his lieutenant in Spain, to aſſemble all the forces in the ſouthern provinces, and drive the Chriſtians beyond the Douro. Iſhmael immediately began to prepare for putting theſe orders in execution; and having added a conſiderable body of troops brought from Barbary to thoſe whom he had raiſed in Spain, the whole army was very numerous. He was met by Don Alonſo of Portugal, in the plains of Ourique, on the banks of the river Tayo; and Iſhmael took all poſſible means to prevent the Chriſtians from paſſing that river, becauſe his own cavalry, in which the ſtrength of his army chiefly conſiſted, had thus more room to act. The Portugueſe forces were very inconſiderable in number in compariſon of the Moors; but Iſhmael, being too confident of victory, divided his army into 12 bodies, and diſpoſed them in ſuch a manner as might beſt prevent the flight, not ſuſtain the attack, of the Chriſtians. The conſequence was, that his army was overthrown with incredible ſlaughter, and a vaſt number of priſoners taken, among whom were 1000 Chriſtians, of the ſect ſtyled *Mozarabians*, whom, at the requeſt of Theotonus, prior of the Holy Croſs, Don Alonſo ſet at liberty with their wives and children, and procured them ſettlements in his own dominions.

8 Don Alonſo aſſumes the title of king.

After this ſignal victory, gained in the year 1139, Don Alonſo was proclaimed king by his ſoldiers, and ever after retained that title, renouncing all kind of ſubjection to the crown of Spain. Being very deſirous, however, of bringing down the power of the emperor, he entered into a league with Raymond count of Barcelona and regent of the kingdom of Arragon againſt that prince. In conſequence of this treaty, he entered Galicia with a conſiderable force on one ſide, while Don Raymond did the ſame on the other. Neither of theſe enterpriſes, however, ſucceeded. The Portugueſe monarch met with a ſevere check in his expedition into Galicia, where he received a dangerous wound, and had ſome of the nobility who attended him taken priſoners. At the ſame time he received intelligence that the Moors had invaded his dominions, ſo that he was obliged to retire; which, however, was not done in ſufficient time to prevent the ſtrong fortreſs of Leyria from falling into their hands. This fortreſs they demoliſhed, and put all the garriſon to the ſword; but the king cauſed it to be rebuilt ſtronger than before, and put a more numerous garriſon into it; however, he undertook nothing farther this campaign. The war continued with various ſucceſs till the year 1145, when the king projected an enterpriſe againſt Santaren, a ſtrong city about 12 miles from Liſbon. In this he luckily ſucceeded: and by that means gained a conſiderable tract of country, and a ſtrong barrier to his dominions.

9 Reduces Liſbon and 12 other cities.

After this ſucceſs Don Alonſo cauſed himſelf with much ceremony to be choſen and crowned king of Portugal before an aſſembly of the ſtates, where he alſo ſolemnly renounced all dependence on the crown of Spain, declaring, that if any of his ſucceſſors ſhould condeſcend to pay tribute or to do homage to that crown, he was unworthy of enjoying the kingdom of Portugal. The next year the king undertook the recovery of Liſbon out of the hands of the Moors; and concerning this expedition there are ſuch numbers of fables, that it is almoſt impoſſible to come at the truth. What can be gathered from theſe accounts is, that he undertook the ſiege with a ſmall army, and was able to make but little progreſs in it, partly from the ſtrength of the place, and partly from the numerous garriſon by which it was defended. At length, fortunately for Don Alonſo, a fleet of adventurers, French, Engliſh, Germans, and Flemings, that were going to the Holy Land, anchored at the mouth of the river Tagus, whoſe aſſiſtance he demanded, as not altogether foreign to their deſign of making war on the infidels. His requeſt was readily granted; and, with their aſſiſtance, Liſbon was ſpeedily reduced; which conqueſt ſo much raiſed the reputation of this monarch, and brought ſuch numbers to recruit his army, that before the end of the year 1147 he had reduced 12 other conſiderable cities.

10 Has his regal dignity confirmed by the pope.

For many years after this, Don Alonſo was ſucceſsful in all his undertakings. He ſettled the internal government of his kingdom, procured a bull from pope Alexander III. confirming his regal dignity, undertook many ſucceſsful expeditions againſt the Moors, and became maſter of four of the ſix provinces which compoſe the preſent kingdom of Portugal. In all his undertakings he was aſſiſted by the councils of his queen Matilda, who was a woman of great capacity, and ſufficient for the government of the kingdom in her huſband's abſence. By her he had a numerous offspring, particularly three daughters; the eldeſt of whom, Donna Mafalda or Mathilda, was married to the king of Arragon; the ſecond, Urraca, to Don Ferdinand king of Leon; and the third, Thereſa, to Philip earl of Flanders.

11 His unſucceſsful war with Don Ferdinand of Spain.

In 1166, however, the king thought proper, from what provocation we know not, to invade the dominions of his ſon-in-law Don Ferdinand; and poſſeſſed himſelf of Limmia and Turon, two cities of Galicia, in which he put ſtrong garriſons. The next year, elated with his ſucceſs, he marched with a numerous army towards Badajos, which he inveſted; on the news of which, Don Ferdinand, who had aſſembled a large army at Ciudad Rodrigo, marched to its relief. Yet before he could come within ſight of it, it had ſurrendered to the king of Portugal; upon which Don Ferdinand came to a reſolution of beſieging his antagoniſt in his newly conquered city; which Don Alonſo perceiving, endeavoured to draw out his forces into the field. Though he was at that time upwards of 70 years of age, he was himſelf on horſeback, and puſhing forwards at the head of his horſe to get out at the gate, he ſtruck his leg againſt one of the bolts with ſuch violence that the bone was ſhattered to pieces. This accident occaſioned ſuch confuſion, that the Portugueſe troops were eaſily beaten, and Don Alonſo was taken priſoner. He was exceedingly mortified by this diſgrace, eſpecially as he had no great reaſon to expect very kind treatment from his ſon in-law. However, the king of Leon behaved towards him with the greateſt reſpect and affection. He deſired him to lay aſide all thoughts of buſineſs, and attend to his cure; but finding him reſtleſs and impatient, he aſſured him that he expected nothing more than to have things put into the ſame condition as before the war, and that they might live in peace and friendſhip for the future: to which the king of Portugal moſt readily aſſented; but returned to his dominions before his cure was perfected, which was the cauſe of his being lame all the reſt of his life. However, this did not abate his military ardour; for, notwithſtanding this inconvenience, his courage tranſported him into the field whenever he was called by the intereſt of his ſubjects. Towards the end of his reign, an opportunity ſeemed to preſent itſelf of obtaining once for all an entire releaſe from the diſagreeable pretenſions of the king of Leon, who, it ſeems, had inſiſted on the king of Portugal's doing homage for his kingdom. The opportunity which now preſented itſelf was a quarrel between the king of Leon and his nephew Don Alonſo king of Caſtile. The latter aſked aſſiſtance from the king of Portugal, which was readily granted. But Don Ferdinand, having received intelligence that the infant Don Sancho (the king's eldeſt ſon) was advancing towards Ciudad Rodrigo, aſſembled his troops on that frontier with ſuch diligence, that he was enabled to attack him unexpectedly, and entirely defeated him. Underſtanding, however, that Don Sancho was recruiting his forces with great diligence, he

12 Don Sancho's ſucceſs againſt the Moors.

he let him know that they might be much better employed againſt the infidels, who remained careleſs and unprepared, expecting the iſſue of the war. Don Sancho made a proper uſe of this advice; and, after making ſome motions to amuſe the enemy, made a ſudden irruption into Andaluſia, penetrating as far as Triana, one of the ſuburbs of Seville. The Moors aſſembled their forces in order to attack him on his retreat; but Don Sancho having firſt fatigued them by the celerity of his march, at length choſe a ſtrong camp, and, having given his troops time to repoſe, drew them out and offered the enemy battle. The Moors accepted the challenge, but were entirely defeated; and Don Sancho returned into Portugal with ſpoils to an immenſe amount. For ſome years after the war was continued without any remarkable event; but, in 1184, Joſeph king of Morocco, having already tranſported multitudes of men from Barbary, at length followed in perſon with a prodigious army, and carried all before him as far as the Tayo. He appeared before the city of Santaren; but having wearied and reduced his army by unſucceſsful aſſaults on that place, he was attacked by the Portugueſe forces aſſiſted by Ferdinand of Leon, entirely defeated, and himſelf killed. By this victory, the Portugueſe were left at liberty to improve the interior part of their country, and fortify their frontiers; and during this interval, the king died in the 76th year of his age, in the year 1185.

13
His wiſe adminiſtration when king.

Don Alonſo was ſucceeded by his ſon Don Sancho I. Of this prince it is remarkable, that, before he aſcended the throne, he was of a reſtleſs and warlike diſpoſition; but no ſooner did he come to the poſſeſſion of the kingdom, than he became a lover of peace, and began with great aſſiduity to repair the cities that had ſuffered moſt by the war, and to repeople the country around them. By his ſteady attention to this, he in a very ſhort time quite altered the appearance of his territories, and procured to himſelf the glorious title of *The reſtorer of cities, and father of his country*. In the year 1189, a fleet, compoſed for the moſt part of Engliſh veſſels, but having on board a great number of adventurers of other nations bound to the Holy Land, entered the river of Liſbon. They were very kindly received, and ſupplied with all kinds of refreſhments by Don Sancho, who took this opportunity of ſoliciting them to aſſiſt him in a deſign he had formed of attacking the city of Silves in Algarve; to which they readily yielded. Having joined a ſquadron of his own galleys, and marched a body of troops by land, the place was reduced, and the Engliſh, according to agreement, rewarded with the plunder. But, in a ſhort time, the Moors from Africa having again invaded Portugal, the town was ſeveral times taken and retaken, till at laſt Don Sancho, being ſenſible of the difficulties that would attend the keeping of it, cauſed it to be demoliſhed. His laſt enterpriſe was the reduction of Elvas; ſoon after which he died with the reputation of the beſt economiſt that ever ſat on the throne of Portugal. With the character of being rather liberal than avaricious, he had amaſſed a treaſure of more than 700,000 crowns in ready money, beſides 1400 merks of ſilver and 100 of gold plate, which he diſpoſed of ſome time before his death. He was interred by his own command with much leſs pomp than his father, in the cathedral of Coimbra; and when his body was taken up 400 years after by order of the king Don Emanuel that it might be laid in a new tomb, it was found uncorrupted.

14
Differences with Caſtile.

The hiſtory of Portugal affords ſcarce any event of importance till the year 1289; when, in the reign of Don Denis, a difference commenced with Caſtile, which ſubſiſted for a long time. Frequent reconciliation took place; but theſe were either of very ſhort duration, or never ſincere. At length, in the reign of John I. Don Juan of Caſtile, who had alſo pretenſions to the crown of Portugal, invaded that kingdom at the head of the whole force of his dominions, and with the flower of the Caſtilian nobility entered the province of Alentego. According to the Portugueſe hiſtorians, he beſieged the city of Elvas without effect; which diſappointment enraged him to ſuch a degree, that he determined next year to invade Portugal a ſecond time, and ruin all the country before him. Accordingly, having collected an army of 30,000 men, he invaded Portugal, took and ruined ſeveral places, while king John lay inactive, with a ſmall army, waiting for ſome Engliſh ſuccours which he expected. At laſt he ventured an engagement with the forces which he had; and, notwithſtanding the great ſuperiority of the enemy, obtained a complete victory; after which he made an irruption into Caſtile, and had the good fortune to gain another battle, which fixed him firmly on the throne of Portugal. The Caſtilians were obliged to conſent to a truce of three years, which was ſoon after improved into a laſting peace.

15
The Caſtilians entirely defeated.

16
The city of Ceuta taken from the Moors.

In 1414, King John undertook an expedition againſt the Moors in Barbary, where he commanded in perſon; but before he ſet out, his queen (Philippa the daughter of John duke of Lancaſter) died of grief at the thoughts of his abſence. The expedition, however, proved ſucceſsful, and the city of Ceuta was taken from the Moors almoſt at the firſt aſſault: but ſcarce had the king left that country, when the princes of Barbary formed a league for the recovery of it; and though they were defeated by the young princes of Portugal, whom John again ſent into Barbary, yet the trouble of keeping it was ſo great, that ſome of the king's council were of opinion that the town ſhould be demoliſhed. But John, having conſidered the arguments on both ſides, determined to keep the city; and therefore enlarged and ſtrengthened the fortifications, augmenting his forces there to 6000 foot and 2500 horſe, which he hoped would be ſufficient for keeping off the attacks of the Moors.

King John died in 1428, and was ſucceeded by his eldeſt ſon Edward. He undertook an expedition againſt Tangier in Barbary: but the event proved very unfortunate; the Portugueſe being ſo ſhut up by the Moors, that they were obliged to offer Ceuta back again, in order to obtain leave to return to Portugal. The king's ſon, Don Ferdinand, was left as an hoſtage for the delivery of Ceuto; but was, with the utmoſt cruelty and injuſtice, left in the hands of the infidels, by the king and council of Portugal, who conſtantly refuſed to deliver up the place. Many preparations indeed were made for recovering the prince by force; but before any thing could be accompliſhed the king died in 1430, which put an end to all theſe deſigns. See PEDRO (Don).

17
Paſſage to the Eaſt Indies diſcovered.

The war with Barbary continued at intervals, but with little ſucceſs on the part of the Portugueſe; and till the year 1497, there is no event of any conſequence recorded in the hiſtory of Portugal. This year was remarkable for the diſcovery of the paſſage to the Eaſt Indies by the Cape of Good Hope. The enterpriſing ſpirit of the Portugueſe had prompted them to undertake voyages along the coaſt of Africa for a conſiderable time before; but when they undertook their firſt voyage of diſcovery, it is probable that they had nothing farther in view than to explore thoſe parts of the coaſt of Africa which lay neareſt to their own country. But a ſpirit of enterpriſe, when rouſed and put in motion, is always progreſſive; and that of the Portugueſe, though ſlow and timid in its firſt operations, gradually acquired vigour, and prompted them to advance along the weſtern ſhore of the African continent, far beyond the utmoſt boundary of ancient navigation in that direction. Encouraged by ſucceſs, it became more adventurous, deſpiſed dangers which formerly appalled it, and ſurmounted difficulties which it once deemed inſuperable. When the Portugueſe found in the torrid zone, which the ancients had pronounced to be uninhabitable, fertile countries, occupied by numerous nations; and perceived that the continent of Africa, inſtead of extending in breadth towards the weſt, according to the opinion of Ptolemy, appeared to contract itſelf, and to bend eaſtwards, more extenſive proſpects opened to their view, and inſpired them with hopes of reaching India, by continuing to hold the ſame courſe which they had ſo long purſued.

Robertſon's India.

18 Circumſtances which facilitated the diſcovery.

After ſeveral unſucceſsful attempts to accompliſh what they had in view, a ſmall ſquadron ſailed from the Tagus under the command of Vaſco de Gama, an officer of rank, whoſe abilities and courage fitted him to conduct the moſt difficult and arduous enterpriſes. From unacquaintance, however, with the proper ſeaſon and route of navigation in that vaſt ocean through which he had to ſteer his courſe, his voyage was long and dangerous. At length he doubled that promontory, which, for ſeveral years had been the object of terror and of hope to his countrymen. From that, after a proſperous navigation along the ſouth-eaſt of Africa, he arrived at the city of Melinda, and had the ſatisfaction of diſcovering there, as well as at other places where he touched, people of a race very different from the rude inhabitants of the weſtern ſhore of that continent, which alone the Portugueſe had hitherto viſited. Theſe he found to be ſo far advanced in civilization and acquaintance with the various arts of life, that they carried on an active commerce, not only with the nations on their own coaſt, but with remote countries of Aſia. Conducted by their pilots, who held a courſe with which experience had rendered them well acquainted, he ſailed acroſs the Indian ocean, and landed at Calecut, on the coaſt of Malabar, on the 22d of May 1498, ten months and two days after his departure from the port of Liſbon.

19 The king of the country jealous of his new viſitors.

The ſamorin, or monarch of the country, aſtoniſhed, at this unexpected viſit of an unknown people, whoſe aſpect, and arms, and manners, bore no reſemblance to any of the nations accuſtomed to frequent his harbours, and who arrived in his dominions by a route hitherto deemed impracticable, received them at firſt with that fond admiration which is often excited by novelty; but in a ſhort time, from whatever motives, he formed various ſchemes to cut off Gama and his followers. The Portugueſe admiral, however, was not to be over-reached by ſuch politics as his. From every danger to which he was expoſed, either by the open attacks or ſecret machinations of the Indians, he extricated himſelf with ſingular prudence and dexterity, and at laſt ſailed from Calecut with his ſhips, loaded not only with the commodities peculiar to that coaſt, but with many rich productions of the eaſtern parts of India. He returned to Portugal in two years after his ſailing from the Tagus, but with a great loſs of men; for out of 148 perſons whom he took out with him, only 55 returned. The king received him with all poſſible teſtimonies of reſpect and kindneſs; created him count of Videgueira; and not only declared him admiral of the Indies, but made that office hereditary in his family.

20 The Venetians dread the ruin of their commerce.

On the firſt intelligence of Gama's ſucceſsful voyage, the Venetians, with the quick-ſighted diſcernment of merchants, foreſaw the immediate conſequence of it to be the ruin of that lucrative branch of commerce which had contributed ſo greatly to enrich and aggrandize their country; and they obſerved this with more poignant concern, as they were apprehenſive that they did not poſſeſs any effectual means of preventing, or even retarding, its operation.

21 Account of the ſettlement of the Portugueſe in India.

The hopes and fears of both were well-founded. The Portugueſe entered upon the new career opened to them with activity and ardour, and made exertions, both commercial and military, far beyond what could have been expected from a kingdom of ſuch inconſiderable extent. All theſe were directed by an intelligent monarch, capable of forming plans of the greateſt magnitude with calm ſyſtematic wiſdom, and of proſecuting them with unremitting perſeverance. The prudence and vigour of his meaſures, however, would have availed little without proper inſtruments to carry them into execution. Happily for Portugal, the diſcerning eye of Emanuel ſelected a ſucceſſion of officers to take the ſupreme command in India, who, by their enterpriſing valour, military ſkill, and political ſagacity, accompanied with diſintereſted integrity, public ſpirit, and love of their country, have a title to be ranked with the perſons moſt eminent for virtue and abilities in any age or nation. Greater things perhaps were atchieved by them than were ever accompliſhed in ſo ſhort a time. Within 24 years only after the voyage of Gama, the Portugueſe had rendered themſelves maſters of the city of Malacca, in which the great ſtaple of trade carried on among the inhabitants of all thoſe regions in Aſia, which Europeans have diſtinguiſhed by the general name of the *Eaſt Indies*, was then eſtabliſhed. This conqueſt ſecured to them great influence over the interior commerce of India, while, at the ſame time, by their ſettlements at Goa and Diu, they were enabled to engroſs the trade of the Malabar coaſt, and to obſtruct greatly the long eſtabliſhed intercourſe of Egypt with India by the Red Sea. In every part of the eaſt they were received with reſpect; in many they had acquired the abſolute command. They carried on trade there without rival or controul; they preſcribed to the natives the terms of their mutual intercourſe; they often ſet what price they pleaſed on the goods which they purchaſed; and were thus enabled to import from Indoſtan and the regions beyond it, whatever is uſeful, rare, or agreeable, in greater abundance, and of more various kinds, than had been known formerly in Europe.

Not ſatisfied with this aſcendant which they had acquired in India, the Portugueſe early formed a ſcheme no leſs bold than intereſted, of excluding all other nations from participating of the advantages of commerce with the eaſt; and they accompliſhed one half of what their ambition had planned.

22
Oppoſition made by the Venetians.

In conſequence of this, the Venetians ſoon began to feel that decreaſe of their own Indian trade which they had foreſeen and dreaded. In order to prevent the farther progreſs of this evil, they incited the Soldan of the Mameluks to fit out a fleet in the Red Sea, and to attack thoſe unexpected invaders of a gainful monopoly, of which he and his predeceſſors had long enjoyed undiſturbed poſſeſſion. The Portugueſe, however, encountered his formidable ſquadron with undaunted courage, entirely defeated it, and remained maſters of the Indian ocean. They continued their progreſs in the eaſt almoſt without obſtruction, until they eſtabliſhed there a commercial empire; to which, whether we conſider its extent, its opulence, the ſlender power by which it was formed, or the ſplendor with which the government of it was conducted, there had hitherto been nothing comparable in the hiſtory of nations. Emanuel, who laid the foundation of this ſtupendous fabric, had the ſatisfaction to ſee it almoſt completed. Every part of Europe was ſupplied by the Portugueſe with the productions of the eaſt; and if we except ſome inconſiderable quantity of them, which the Venetians ſtill continued to receive by the ancient channel of conveyance, Europe had no longer any commercial intercourſe with India, and the regions of Aſia beyond it, but by the Cape of Good Hope.

23
Inquiſition introduced into Portugal.

In September 1522, King Emanuel died of an epidemical fever, and was ſucceeded by his ſon John III. The moſt remarkable tranſaction of this prince's reign was the introduction of the inquiſition into his dominions. This happened in the year 1525, or, as ſome ſay, in 1535. A famine happening to ceaſe in a ſhort time after it was introduced, the prieſts perſuaded the ignorant multitude that it was a bleſſing from heaven on account of the erecting ſuch an holy tribunal. However, it was not long before the bulk of the nation perceived what kind of a bleſſing the inquiſition was: but their diſcernment came too late; for by that time the inquiſitors had acquired ſuch power, that it became equally dangerous and ineffectual to attempt diſcloſing any of their myſteries.

In the mean time Solyman the Magnificent, the moſt enlightened monarch of the Ottoman race, obſerving the power and the opulence of the Portugueſe riſing, and attributing it to its proper cauſe, and eager to ſupplant them, ſent orders to the baſhaw of Egypt to employ his whole ſtrength againſt the Chriſtians in the Eaſt Indies. The baſhaw, in obedience to theſe orders, ſailed out from the Red Sea with a greater naval force than ever the Mohammedans had employed before; having 4000 Janizaries, and 16,000 other land troops on board. Yet, by the courage and conduct of the Portugueſe officers and ſoldiers, all this mighty armament was defeated, and their Eaſt India poſſeſſions ſaved from the danger which threatened them. In Africa likewiſe the king of Fez was baffled before the town of Safi, and freſh quarrels breaking out among the princes gave great relief to the Chriſtians, who had long been obliged to carry on a defenſive war, and had more than once been on the very brink of ruin. For a long time indeed their ſafety had been derived only from the quarrels of the Moors among themſelves; for ſuch was the envy and jealouſy which reigned among the Portugueſe, that they could never unite heartily in oppoſing the common enemy; and therefore, had their enemies united againſt them, they muſt certainly have been cut off. But whenever the cheriffs quarrelled with each other, one party was ſure to have recourſe to the Portugueſe; who, by ſending them a ſmall ſupply, ſecured quiet to themſelves, and had the pleaſure of ſeeing their enemies deſtroy one another. Yet in the end even this had bad conſequences; for, on one hand, it kept up a martial ſpirit among the Moors, and on the other it made them acquainted with the Portugueſe diſcipline; ſo that after every ſhort interval of repoſe they not only found them as much enemies as before, but much more formidable than ever. The conſequence of all this was, that King John began to apprehend that the conqueſt of Barbary was impoſſible, and therefore to limit his deſires to the keeping of thoſe few fortreſſes which he had already; which, though a neceſſary and prudent meaſure, diſpleaſed the generality of his ſubjects.

24
Bad ſtate of affairs in Barbary.

King John exerted himſelf much in the ſettlement of Brazil in South America, which he brought into a very good ſtate, cauſed ſeveral ſtrong towns to be erected there, and took all poſſible methods to encourage the converſion of the natives to Chriſtianity. He alſo made many regulations for the welfare and happineſs of his ſubjects. The diſputes of the nobility about precedency were frequently attended with very diſagreeable conſequences, which made the king reſolve once for all to ſettle them by eſtabliſhed rules; and the rules eſtabliſhed by him on this occaſion have ſubſiſted ever ſince, and in a great meaſure prevent theſe altercations. He had other great deſigns in his mind, particularly with regard to the reformation, which he had puſhed very far with reſpect to religious perſons of both ſexes; but, on a cloſe examination of his affairs, he found his ſubjects in general to have been ſo much injured by his leaving their concerns to the inſpection of his council, that he was thrown by the grief of it into a kind of apoplexy, from which he never recovered. His death happened in June 1557; and he was ſucceeded by his ſon Don Sebaſtian III. an infant of three years of age.

After the death of King John, the adminiſtration remained in the hands of the queen, grandmother to Sebaſtian, who behaved with great prudence and circumſpection. The Moors, however, ſuppoſing that under a minority they might be able to diſpoſſeſs the Chriſtians of ſuch places as they held in Barbary, laid cloſe ſiege to Maſagnan. But the queen-regent ſent ſuch ſpeedy ſuccours, and promiſed ſuch rewards to thoſe who diſtinguiſhed themſelves, that the Moors, though they brought 80,000 men into the field, were obliged to abandon the enterpriſe. This was at firſt magnified as a high inſtance of the queen's capacity and wiſdom; but in a ſhort time the natural averſion which the Portugueſe had to the government of women, together with the prejudice they had againſt her country, as being a Caſtilian, appeared ſo plainly, and gave her ſo much uneaſineſs, that of her own accord ſhe reſigned her authority into the hands of Cardinal Don Henry

25 Prepoſterous education of the young king Sebaſtian.

the king's brother. By him Don Alexius de Meneſes was appointed the king's governor, and Gonſales de Gomera with two other prieſts his preceptors. By means of thoſe inſtructors the king's education was totally marred. His governor aſſiduouſly inculcated upon him that the chief virtue of a king was courage; that danger was never to be avoided, but always ſurmounted, let the occaſion be what it would. His other tutors, inſtead of inſtructing him in the true religion, only inſpired him with an abhorrence of profeſſed infidels: the conſequence of all which was, that he became raſh, inconſiderate, and obſtinate; all which qualities conſpired to draw upon him the cataſtrophe which ruined both him and the kingdom.

26 He undertakes an expedition againſt Africa.

After the king was grown up to man's eſtate, his deſire was to diſtinguiſh himſelf againſt the infidels. He himſelf choſe an expedition to the Eaſt Indies; but the prime miniſter Alcoçova, who did not chooſe to attend his monarch to ſuch a diſtance, ſubſtituted Africa in its ſtead. This expedition the king entered into in the moſt inconſiderate and abſurd manner. He firſt ſent over Don Antonio prior of Crato, with ſome hundreds of ſoldiers; carried his principal courtiers over with him from a hunting match, and without equipages; he then ſent for the duke of Aveyro, with ſuch troops as he could collect on the ſhort warning he had got; and when all theſe were aſſembled, the king ſpent his time in hunting, and ſlight excurſions againſt the enemy, without doing any thing of conſequence, except expoſing his perſon upon all occaſions. At length he returned to Portugal in ſuch tempeſtuous weather, that his ſubjects had given him up for loſt; when they were agreeably ſurpriſed by his unexpected arrival in the river of Liſbon, which they celebrated with the greateſt rejoicings.

27 Account of his forces.

The little ſucceſs which attended the king in this expedition ſerved only to inflame him more with deſire for another; ſo that from the time he returned, he ſeemed to think on nothing elſe. He was highly delighted alſo with an accident which at this time furniſhed him with a pretence for war, though of that he ſtood in no great need. Muley Hamet, king of Fez and Morocco, had been diſpoſſeſſed of his dominions by his uncle Muley Moloch. At the beginning of this war Don Sebaſtian had offered him his troops in Africa, which offer was rejected with contempt: but now being a fugitive, and having in vain applied for aſſiſtance to Philip of Spain, Muley Hamet applied to the king of Portugal; and, that he might the more eaſily ſucceed, cauſed the fortreſs of Arzila, which his father had recovered, to be reſtored to the Portugueſe. The king was in rapture at this event, and fancied that his glory would exceed that of all his predeceſſors. He was adviſed againſt this expedition, however, by all his friends. King Philip of Spain having done every thing to diſſuade him from it in a perſonal conference, ſent Franciſco Aldana, an old and experienced officer, to Morocco; and at his return ordered him to attend Don Sebaſtian, in order to give him an account of the ſtate of affairs in that country. This he performed with the greateſt fidelity, but without any effect. The queen dowager and cardinal united in their endeavours to divert him from this unfortunate enterpriſe; but he treated them both with ſo little reſpect, that his grandmother broke her heart; and the cardinal, to ſhow his diſtaſte to the meaſure, retired to Evora without coming either to court or council; which example was followed by many of the nobles. Many of theſe, however, ſent very free remonſtrances to the king on the impropriety of his conduct; and King Philip ſent to him the duke de Medina Celi, once more to lay before him the reaſons why he thought his ſcheme impracticable, and to put him in mind that he had no hand in puſhing him upon his deſtruction, or of concealing from him the dangers into which he ſeemed determined to plunge himſelf and his ſubjects. Laſtly, he received a letter on the ſubject from Muley Moloch himſelf, wherein that prince explained to him his own right to the crown of Fez, and ſhowed that he had only diſpoſſeſſed a tyrant and a murderer, who had therefore no right to his friendſhip or aſſiſtance. He next aſſured him that he had no reaſon to fear either the power or neighbourhood of the Portugueſe; as a proof of which, and as a mark of his eſteem, he was content to make him a preſent of ten miles of arable ground round each of the fortreſſes he poſſeſſed in Africa, and which indeed were no more than four, viz. Tangier, Ceuta, Maſagan, and Arzila. At the ſame time he addreſſed himſelf to King Philip of Spain, with whom he was on good terms, deſiring him to interpoſe with his nephew Sebaſtian, that things might be yet adjuſted without the effuſion of human blood. But the king of Portugal was deaf to all ſalutary advice; and therefore paid no regard to this letter, nor to the remonſtrances of his uncle. On the 24th of June 1577, therefore, he ſet ſail from the bar of Liſbon with a fleet of 50 ſhips and five galleys, twelve pieces of cannon, and tranſports and tenders, making up near 1000 ſail. His troops conſiſted of 9000 Portugueſe foot; 3000 Germans; 700 Italians commanded by Sir Thomas Stukeley, an Engliſh exile, but remarkably brave; 2000 Caſtilians and 300 volunteers, commanded by Don Chriſtopher de Tuvara maſter of the horſe, a man of courage, but without either conduct or experience. He touched firſt at Lagos bay in the kingdom of Algarve, where he remained for four days: thence he proceeded to Cadiz; where he was magnificently feaſted for a weak by the duke de Medina Sidonia, who took the opportunity once more, by order of Philip, of diſſuading him from proceeding further in perſon. But this exhortation proved as fruitleſs as the reſt; and the king having ſailed with a ſtrong detachment for Tangier, ordered Don Diego de Souza, his commander in chief, to follow with the remaining part of the army.

The troops landed on the coaſt of Africa without any bad accident, and joined at Arzila. Here the king was met by the cheriff Muley Hamet, on whoſe account he had undertaken the war, who delivered him his ſon Muley, a boy of 12 years of age, as a hoſtage, and brought a reinforcement of 300 Moors. The boy was ſent to Maſagon under a ſtrong guard; but the father remained in the Portugueſe camp. Here it was reſolved in a council of war to reduce the town of Larache, but it was diſputed whether the troops ſhould proceed thither by land or ſea. Don Sebaſtian, who eſpouſed the former opinion, finding himſelf oppoſed by Muley Hamet, gave him ſuch a rude anſwer, that he left his preſence in diſcontent; after which the king's opinion prevailed, and the army began its march on the 29th of July. As they proceeded, the king received a letter from the duke of Alba, requeſting him to attempt nothing beyond the taking of the town of Larache. Along with the letter was ſent an helmet which had been worn by Charles V.

28 Movements and diſpoſition of the armies.

On the other hand Muley Moloch, having intelligence of this formidable invaſion, took the field, though at that time ſo ill of a fever that he could not ſit on horſeback, with 40,000 foot and 60,000 horſe. He conducted every thing, notwithſtanding his diſtreſſed ſituation, with the greateſt prudence. Finding ſome reaſon to ſuſpect that part of his army were deſirous of going over to his rival, he proclaimed that ſuch as inclined to join their old maſter were at liberty to do it. This at once put a ſtop to the defection, and only a very few made uſe of the liberty which was granted them. Standing in doubt likewiſe of the fidelity of a body of 3000 horſe, he ſent them to reconnoitre the enemy, by which act of confidence he ſecured them. Still, however, he feared that his officers might be corrupted by the Portugueſe gold; for which reaſon he changed the diſpoſition of his army entirely, ſo that none of his officers commanded the corps to which they had been accuſtomed; and therefore, having new men to deal with, had none whom they could truſt.

Having taken theſe precautions, he advanced againſt the Portugueſe army with ſuch celerity, that he came in ſight of them on the 3d of Auguſt. On this Don Sebaſtian called a council of war; in which many who out of complaiſance had given their opinions for this march, were now for returning. They were ſeparated from the enemy by a river, and the Moors were maſters of the ford, ſo that it was impoſſible to force them immediately in their poſts; neither was it practicable for them to wait for a more favourable opportunity, becauſe they had no proviſions. The foreign officers, on the contrary were of opinion that fighting was now become neceſſary, and a retreat dangerous. This, however, was violently oppoſed by the cheriff, who ſaw plainly that they ran a great riſk of being defeated and of loſing all, while at the ſame time they were not certain of gaining any thing of conſequence though they ſhould be victorious: whereas, if they drew down towards the ſea, they might entrench themſelves till they were relieved by their fleet; during which interval if Muley Moloch ſhould die, he looked upon it as certain that a great part of the army would deſert to him, which would render him maſter not only of the kingdom, but of the fate of the Chriſtians alſo. When he found that the king was bent on fighting, he only requeſted that the engagement might be delayed till 4 o'clock in the afternoon, that, in caſe of a defeat, they might have ſome chance of eſcaping: but even in this he could not prevail; for the king having diſpoſed of every thing for a battle the next day, was impatient to begin the onſet as ſoon as it was light.

In the mean time Muley Moloch was ſo ſenſible of the advantages of his ſituation, that he was inclined to take the whole Portugueſe army priſoners; but finding his diſeaſe increaſe, ſo that he had no hopes of recovery, he came to the reſolution to fight, that his antagoniſt might not avail himſelf of his death. The diſpoſition of the Chriſtian army was very regular and correct, through the care of ſome old officers in Don Sebaſtian's ſervice: the infantry were diſpoſed in three lines; the battalion of volunteers made the vanguard; the Germans commanded by colonel Amberg, and the Italians by Sir Thomas Stuckeley, were on the right; the Caſtilian battalions on the left; the Portugueſe in the centre and rear; the cavalry, conſiſting of about 1500 men, partly on the right under the command of the duke d'Avegro, to whom the cheriff joined himſelf with his horſe: on the left was the royal ſtandard, with the reſt of the cavalry, under the command of the duke of Barcelos eldeſt ſon to the duke of Braganza, Don Antonio prior of Crato, and ſeveral other perſons of great rank. The king took poſt at firſt with the volunteers. Muley Moloch diſpoſed alſo his troops in three lines: the firſt conſiſted of the Andaluſian Moors, commanded by three officers who had diſtinguiſhed themſelves in the wars of Granada; the ſecond of renegadoes; and the third of the natives of Africa. They moved in a half moon, with 10,000 horſe on each wing, and the reſt in the rear, with orders to extend themſelves in ſuch a manner as to encompaſs the Chriſtian army. Muley Moloch, though extremely weak, was taken out of his litter and ſet on horſeback, that he might ſee how his commands had been obeyed; and being perfectly ſatisfied with the ſituation of his troops, he directed the ſignal of battle to be given.

29 The Portuguese army entirely feated.

The Chriſtians advanced with the greateſt reſolution; broke the firſt line of the Mooriſh infantry, and diſordered the ſecond. On this Muley Moloch drew his ſword, and would have advanced to encourage his troops, but that his guards prevented him; on which his emotion of mind was ſo great, that he fell from his horſe. One of his guards caught him in his arms, and conveyed him to his litter; where he immediately expired, having only time to lay his finger on his lips by way of enjoining them to conceal his death. But by this time the Mooriſh cavalry had wheeled quite round, and attacked the Chriſtian army in the rear: upon which the cavalry in the left wing made ſuch a vigorous effort that they broke the Portugueſe or the right; and at this time the cheriff, in paſſing a rivulet, was drowned. In this emergency, the Germans, Italians, and Caſtilians, did wonders; but the Portugueſe, according to their own hiſtorians, behaved indifferently. Attacked on all ſides, however, they were unable to reſiſt; and the whole army, except about 50 men, were killed or taken priſoners. The fate of the king is variouſly related. According to ſome, he had two horſes killed under him, and then mounted a third. His braveſt officers were killed in his defence; after which the Moors ſurrounded him, ſeized his perſon, ſtripped him of his ſword and arms, and ſecured him. They immediately began to quarrel about whoſe priſoner he was; upon which one of the generals rode in among them, crying, "What, you dogs, when God has given you ſo glorious a victory, would you cut one anothers throats about a priſoner?" at the ſame time diſcharging a blow at Sebaſtian, he brought him to the ground, when the reſt of the Moors ſoon diſpatched him. Others affirm, that one Lewis de Brito meeting the king with his ſtandard wrapped round him, Sebaſtian cried out, "Hold it faſt, let us die upon it!" upon which charging the Moors, he was ſeized, reſcued by Brito, who was himſelf taken with the ſtandard, and carried to Fez. He affirmed, that after he was taken, he ſaw the king at a diſtance, and unpurſued. Don Lewis de Lima met him afterwards making towards the river; and this is the laſt account we have of his being ſeen alive.

Muley Hamet, the brother of Muley Moloch, was proclaimed king by the Moors immediately after the battle. Next day, having ordered all the priſoners to be brought before him, the new ſovereign gave orders to ſearch for the body of Don Sebaſtian. The king's valet-de-chambre brought back a body, which he ſaid was that of his maſter, but ſo disfigured with wounds, that it could not well be known; ſo that notwithſtanding the moſt diligent ſearch, this monarch's death could never be properly authenticated. This body, however, was preſerved by Muley Hamet, who delivered it up as the body of Don Sebaſtian to King Philip of Spain. By him it was ſent to Ceuta, from whence it was tranſported to Portugal, and buried among his anceſtors in the monaſtery at Belem, with all poſſible ſolemnity.

30
Portugal conquered by Philip of Spain.

By this terrible diſaſter, the kingdom of Portugal, from being the moſt eminent, ſunk at once into the loweſt rank of the European ſtates. All the young nobility were cut off, or carried into ſlavery: the kingdom was exhauſted of men, money, and reputation; ſo that Don Henry, who aſſumed the government after the death of his brother Don Sebaſtian, found himſelf in a very diſagreeable ſituation. The tranſactions of his reign were quite trifling and unimportant; but after his death a great revolution took place. The crown of Portugal was claimed by three different competitors; viz. the prince of Parma, the dutcheſs of Braganza, and Philip of Spain. Whatever might have been the merits of their reſpective claims, the power of Philip quickly decided the conteſt in his favour. He found his ſchemes facilitated by the treachery of the regents, who took the moſt ſcandalous methods of putting the kingdom into his hands. Under pretence of inſpecting the magazines, they took out ſome of the powder, and mixed the reſt with ſand: they appointed an agent to go to France for ſuccours, from whence they knew that they could not arrive in time; they diſſolved the ſtates as ſoon as they diſcovered that they were bent on maintaining the freedom of the nation; and, under a ſhow of confidence, ſent off to diſtant places ſuch of the nobility as they ſuſpected.

King Philip, finding every thing in his favour, commanded the duke of Alva to invade Portugal, at the head of 20,000 men. The people, perceiving that they were betrayed, exclaimed againſt the governors, and placed on the throne Don Antonio prior of Crato. But his forces being inexperienced, and he himſelf behaving in a very improper manner, he was quickly defeated by the duke of Alva, and forced to fly out of the kingdom, which he effected with great difficulty. On his flight the whole kingdom ſubmitted, together with the garriſons in Barbary, the ſettlements on the weſtern coaſt of Africa, of Brazil, and in the Eaſt Indies. All the Madeiras, however, except the iſle of St Michael, held out for Don Antonio until they were reduced, and the French navy, who came to their aſſiſtance, entirely defeated and deſtroyed.

31
Terms granted by him to his new ſubjects,

Philip made his entry into Liſbon as ſoon as the kingdom was totally reduced, and endeavoured to conciliate the affections of the people by confirming the terms which he had before offered to the ſtates. Theſe terms were, that he would take a ſolemn oath to maintain the privileges and liberties of the people: that the ſtates ſhould be aſſembled within the realm, and nothing propoſed in any other ſtates that related to Portugal: that the viceroy or chief governor ſhould be a native, unleſs the king ſhould give that charge to one of the royal family: that the houſehold ſhould be kept on the ſame footing: that the poſt of firſt preſident, and of all offices, civil, military, and judicial, ſhould be filled with Portugueſe; all dignities in the church and in the orders of knighthood confined to the ſame; the commerce of Ethiopia, Africa, and the Indies, reſerved alſo to them, and to be carried on only by their merchants and veſſels: that he would remit all impoſts on eccleſiaſtical revenues: that he would make no grant of any city, town, or juriſdiction royal, to any but Portugueſe: that eſtates reſulting from forfeitures ſhould not be united to the domain, but go to the relations of the laſt poſſeſſor, or be given to other Portugueſe for recompenſe of ſervices: that when the king came to Portugal, where he ſhould reſide as much as poſſible, he ſhould not take the houſes of private perſons for his officers' lodging, but keep to the cuſtom of Portugal: that wherever his majeſty reſided, he ſhould have an eccleſiaſtic, a treaſurer, a chancellor, two maſters of requeſts, with under officers, all of them Portugueſe, who ſhould diſpatch every thing relating to the kingdom: that Portugal ſhould ever continue a diſtinct kingdom, and its revenue be conſumed within itſelf: that all matters of juſtice ſhould be decided within the realm: that the Portugueſe ſhould be admitted to charges in the houſeholds of the king and queen of Spain: that all duties on the frontiers ſhould be taken away: and, laſtly, that Philip ſhould give 300,000 ducats to redeem priſoners, repair cities, and relieve the miſeries which the plague and other calamities had brought upon the people. All theſe conditions, formerly offered and rejected by the Portugueſe, the king now confirmed: but whereas the duke of Oſſuna, by way of ſecurity for theſe conditions, had promiſed them a law, that if the king did not adhere to them, the ſtates ſhould be freed from their obedience, and might defend their right by the ſword, without incurring the reproach of perjury, or the guilt of treaſon; this he abſolutely refuſed to ratify.

32
Cannot conciliate their affections.

All theſe conceſſions, however, did not anſwer the purpoſe; nay, though Philip was to the laſt degree laviſh of honours and employments, the Portugueſe were ſtill diſſatiſfied. This had alſo an effect which was not foreſeen: it weakened the power, and abſorbed the revenues, of the crown; and, by putting it out of the power of any of his ſucceſſors to be liberal in the ſame proportion, it raiſed only a ſhort-lived gratitude in a few, and left a number of malecontents, to which time was continually adding.

33
Is diſturbed by Don Antonio.

Thus Philip, with all his policy, and endeavours to pleaſe, found his new ſubjects ſtill more and more diſguſted with his government, eſpecially when they found their king treating with the utmoſt ſeverity all thoſe who had ſupported Don Antonio. The exiled prince, however, ſtill ſtyled himſelf *king of Portugal*. At firſt he retired to France, and there demanded ſuccours for the recovery of his dominions. Here he found ſo much countenance, that with a fleet of near 60 ſail, and a good body of troops on board, he made an attempt upon the Terceras, where his fleet was beat by the Spaniards; and a great number of priſoners being taken,

ken, all the officers and gentlemen were beheaded, and a great number of meaner people hanged. Don Antonio, notwithſtanding, kept poſſeſſion of ſome places, coined money, and performed many other acts of regal power; but was at length conſtrained to retire, and it was with ſome difficulty that he did ſo, and returned into France. He paſſed from thence into England, where he was well received; and many fitted out privateers to cruiſe againſt the Spaniards under his commiſſion. But after king Philip had ruined the naval power of Portugal as well as Spain, by equipping the armada, Queen Elizabeth made no difficulty of owning and aſſiſting Don Antonio, and even of ſending Sir John Norris and Sir Francis Drake with a ſtrong fleet and a great army to reſtore him. Upon this occaſion Don Antonio ſent his ſon Don Chriſtopher a hoſtage to Muley Hamet king of Fez and Morocco, who was to lend him 200,000 ducats. But king Philip prevented this by ſurrendering Arzila: and this diſappointment, the unſeaſonable enterpriſe upon Corunna, and the diſputes that aroſe between Norris and Drake, rendered that expedition abortive; ſo that, except carrying the plague into England, it was attended with no conſequences worthy of notice. He remained ſome time after in England: but finding himſelf little regarded, he withdrew once more into France, where he fell into great poverty and diſtreſs; and at length dying in the 64th year of his age, his body was buried in the church of the nuns of Ave Maria, with an inſcription on his tomb, in which he is ſtyled *king*. He left ſeveral children behind him, who, on account of his being a knight of Malta, and having made a vow of virginity at his entrance into the order, were looked upon as illegitimate. He preſerved, even to the day of his death, a great intereſt in Portugal; and had drawn from thence, in the courſe of his life, immenſe ſums of money; which had been ſquandered in many fruitleſs negociations and attempts to diſturb the poſſeſſions of king Philip in almoſt all parts of his dominions, and particularly in the Indies, where the Portugueſe were rather more averſe to the Caſtilian yoke, or at leaſt teſtified their averſion more openly, than in Europe.

34 Impoſtors pretending to be Don Sebaſtian.

But Don Antonio was not the only pretender to the crown of Portugal: for the people, partly through the love of their prince, and partly from their hatred to the Caſtilians, were continually feeding themſelves with the hopes that Don Sebaſtian would appear and deliver them; and in this reſpect ſuch a ſpirit of credulity reigned, that it was ſaid proverbially, they would have taken a negro for Don Sebaſtian. This humour put the ſon of a tiler at Alcobaza, who had led a profligate life, and at length turned hermit, to give himſelf out for that prince; and having with him two companions, one of them ſtyled himſelf *Don Chriſtopher de Tavora*, and the other the *biſhop of Guarda*, they began to collect money, and were in a fair way of creating much diſturbance, if the cardinal arch-duke had not cauſed him to be apprehended; and after leading him ignominiouſly through the ſtreets of Liſbon, he who took the name of *Sebaſtian* was ſent to the galleys for life, and the pretended biſhop was hanged. Not long after, Gonſalo Alvarez, the ſon of a maſon, gave himſelf out for the ſame king; and having promiſed marriage to the daughter of Pedro Alonſo, a rich yeoman, whom he created Earl of Torres Novas, he aſſembled a body of about 800 men, and ſome blood was ſpilt before he was apprehended: at length, being clearly proved to be an impoſtor, himſelf and his intended father-in-law were publicly hanged and quartered at Liſbon; which, inſtead of extinguiſhing this humour, farther increaſed it.

35 Account of a remarkable one.

There was, however, a perſon who appeared about 20 years after the fatal defeat of Sebaſtian, at Venice, who created much more trouble. He aſſumed the name of *Don Sebaſtian*, and gave a very diſtinct account of the manner in which he had paſſed his time from that defeat. He affirmed, that he had preſerved his life and liberty by hiding himſelf amongſt the ſlain: that, after wandering in diſguiſe for ſome time in Africa, he returned with two of his friends into the kingdom of Algarve: that he gave notice of this to the king Don Henry: that finding his life ſought, and being unwilling to diſturb the peace of the kingdom, he returned again among the Moors, and paſſed freely from one place to another in Barbary, in the habit of a penitent: that after this he became a hermit in Sicily; but at length reſolved to go to Rome, and diſcover himſelf to the pope. On the road he was robbed by his domeſtics, and came almoſt naked to Venice, where he was known, and acknowledged by ſome Portugueſe. Complaint being made to the ſenate, he was obliged to retire to Padua. But the governor of that city ordering him alſo to depart, he, not knowing what to do, returned again to Venice; where, at the requeſt of the Spaniſh ambaſſador, who charged him not only with being an impoſtor, but alſo with many black and atrocious crimes, he was ſeized, and thrown into priſon. He underwent 28 examinations before a committee of noble and impartial perſons; in which he not only acquitted himſelf clearly of all the crimes that had been laid to his charge, but entered alſo into ſo minute a detail of the tranſactions that had paſſed between himſelf and the republic, that the commiſſioners were perfectly aſtoniſhed, and ſhowed no diſpoſition to declare him an impoſtor; moved more eſpecially by the firmneſs of his behaviour, his ſingular modeſty, the ſobriety of his life, his exemplary piety, and his admirable patience under his afflictions. The noiſe of this was diffuſed throughout Europe, and the enemies of Spain endeavoured every where to give it credit.

The ſtate, however, refuſed to diſcuſs the great point, whether he was or was not an impoſtor, unleſs they were requeſted ſo to do by ſome prince or ſtate in alliance with them. Upon this the prince of Orange ſent Don Chriſtopher, the ſon of the late Don Antonio, to make that demand; and at his requeſt an examination was made with great ſolemnity: but no deciſion followed; only the ſenate ſet him at liberty, and ordered him to depart their dominions in three days. He went therefore, by the advice of his friends, to Padua, but in the diſguiſe of a monk, and from thence to Florence; where he was arreſted by the command of the grand duke, who delivered him to the viceroy of Naples. The count de Lemos, then in poſſeſſion of that dignity, died ſoon after; before whom he was firſt brought; this man aſſerted, he muſt know him to be Don Sebaſtian, ſince he had been twice ſent to him from the king of Spain. He remained priſoner ſeveral years in the caſtle Del Ovo, where he endured incredible hardſhips. At length he was brought out, led with infamy through the ſtreets of the city, and declared to be an impoſtor, who aſſumed the name of *Sebaſtian:* at which words, when proclaimed before him, he ſaid gravely, *And ſo I am.* In the ſame proclamation it was affirmed, that he was in truth a Calabrian; which as ſoon as he heard, he ſaid, *It is falſe.* He was next ſhipped on board a galley as a ſlave; then carried to St Lucar, where he was ſome time confined; from thence he was transferred to a caſtle in the heart of Caſtile, and never heard of more. Some perſons were executed at Liſbon for their endeavours to raiſe an inſurrection on his behalf: but it was thought ſtrange policy, or rather a ſtrange want of policy, in the Spaniards, to make this affair ſo public without proofs; and the attempt to ſilence this objection, by affirming him to be a magician, was juſtly looked upon as ridiculous.

36
Bad conſequences of the Spaniſh adminiſtration.

The adminiſtration of affairs in Portugal, during the reign of Philip, was certainly detrimental to the nation; and yet it does not appear that this flowed ſo much from any ill intention in that monarch, as from errors in judgment. His prodigious preparations for the invaſion of England impoveriſhed all his European dominions; but it abſolutely exhauſted Portugal. The pretenſions of Don Antonio, and the hopes of deſpoiling their Indian fleets, expoſed the Portugueſe to the reſentment of the Engliſh; from which the king having granted away all his domains, wanted power to defend them. Their clamours were not at all the leſs loud for their being in ſome meaſure without cauſe. The king, to pacify them, borrowed money from the nobility upon the cuſtoms, which were the only ſure remedy he had ſtill left; and this was attended with fatal conſequences. The branches, thus mortgaged, became, and continue to this hour, fixed and hereditary; ſo that the merchant was oppreſſed, and the king received nothing. This expedient failing, a tax of three *per cent.* was impoſed, in the nature of ſhip-money, for the defence of the coaſts and the commerce, which for ſome years was properly applied; but it then became a part of the ordinary revenue, and went into the king's exchequer without account. This made way for diverting other appropriated branches; as for inſtance, that for the repair of fortifications, the money being ſtrictly levied, and the works ſuffered to decay and tumble down; and for the maintenance of the conqueſt in Africa, by which the garriſons mouldered away, and the places were loſt. Upon the whole, in the ſpace of 18 years, the nation was viſibly impoveriſhed: and yet the government of Philip was incomparably better than that of his ſucceſſors; ſo that his death was juſtly regretted; and the Portugueſe were taught by experience to confeſs, that of bad maſters he was the beſt.

His ſon Philip, the ſecond of Portugal and the third of Spain, ſat 20 years upon the throne before he made a viſit to Portugal, where the people put themſelves to a moſt enormous expence to receive him; for which they received little more than the compliment, that before his entry into Liſbon, he knew not how great a king he was. He held an aſſembly of the ſtates, in which his ſon was ſworn ſucceſſor. Having done all that he wanted for himſelf, he acquired a falſe idea of the riches of the nation from an immoderate and fooliſh diſplay of them during his ſhort ſtay at Liſbon; and having ſhown himſelf little, and done leſs, he returned into Spain; where he acted the part of a good king upon his death-bed, in deploring bitterly that he never thought of acting it before. The reign of Philip III. and IV. was a ſeries of worſe meaſures, and worſe fortune: all his dominions ſuffered greatly; Portugal moſt of all. The loſs of Ormus in the Eaſt, of Brazil in the Weſt Indies, together with the ſhipwreck of a fleet ſent to eſcort that from Goa, brought the nation incredibly low, and encouraged the conde duke to hope they might be entirely cruſhed. Theſe are the heads only of the tranſactions for 40 years: to enter in any degree into the particulars, is, in other words, to point out the breaches made by the Spaniſh miniſters on the conditions granted by king Philip; which, with reſpect to them, was the original contract, and unalterable conſtitution of Portugal while ſubject to the monarchs of Caſtile; and which, notwithſtanding, they ſo often and ſo flagrantly violated, that one would have imagined they had ſtudied to provoke the wrath of heaven, and inſult the patience of men, inſtead of availing themſelves, as they might have done, of the riches, power, and martial ſpirit of the Portugueſe people.

37
Great loſſes in Aſia and America.

38
The Portugueſe oppreſſed by the Spaniards.

It was the very baſis and foundation of their privileges, that the kingdom ſhould remain ſeparate and independent, and conſequently that Liſbon ſhould continue as much its capital as ever, the ſeveral ſupreme councils and courts reſiding; ſo that the natives of this realm might not be obliged to travel in ſearch of juſtice. So little, or at leaſt ſo ſhort a time, was this obſerved, that neither promotion nor juſtice was to be obtained without journeys, and Madrid was not more the capital of Caſtile than of Portugal. The general aſſembly of eſtates was to be held frequently, and they were held thrice in the ſpace of 60 years; and of theſe twice within the firſt three. The king was to reſide in this realm, as often and as long as poſſible; in compliance with which, Philip I. was there but once, Philip II. but four months, and Philip III. was never there at all. The houſehold eſtabliſhment was ſuppreſſed through all their reigns. The viceroy was to be a native of Portugal, or a prince or princeſs of the blood; yet when any of the royal family bore the title, the power was in reality in the hands of a Spaniard. Thus, when the princeſs of Mantua was vice-queen, the marquis de la Puebla was to aſſiſt in council, and in all diſpatches; and ſhe was to do nothing without his advice. The council of Portugal, which was to be compoſed entirely of natives, was filled with Caſtilians, as the garriſons alſo were, though the contrary had been promiſed. The preſidents of provinces, or corregidors, were to be natives; but by keeping thoſe offices in his own hands, the king eluded this article. No city, town, or diſtrict, was to be given but to Portuguſe: yet the duke of Lerma had Beja, Serpa, and other parts of the demeſnes of the crown, which were formerly appendages of the princes of the blood. None but natives were capable of offices of juſtice, in the revenue, in the fleet, or of any poſt civil or military; yet theſe were given promiſcuouſly to foreigners, or ſold to the higheſt bidder; not excepting the governments of caſtles, cities, and provinces. The natives were ſo far from having an equal chance in ſuch caſes, that no poſts in the preſidials were ever given to them, and ſcarce any in garriſons; and whenever it happened, in the caſe of a perſon of extraordinary merit, whoſe pretenſions could not be rejected, he was either removed, or not allowed to exerciſe his charge;

as fell out to the marquis of Marialva and others. The forms of proceeding, the juriſdiction, the miniſters, the ſecretaries, were all changed, in the council of Portugal; being reduced from five to three, then two, and at laſt to a ſingle perſon.

39
A revolution in favour of the duke of Braganza.

By reaſon of theſe and many other grievances too tedious to be mentioned here, the deteſtation of the Spaniſh government became univerſal; and in 1640 a revolution took place, in which John duke of Braganza was declared king, by the title of John IV. This revolution, as being determined by the almoſt unanimous voice of the nation, was attended with very little effuſion of blood; neither were all the efforts of the king of Spain able to regain his authority. Several attempts indeed were made for this purpoſe. The firſt battle was fought in the year 1644, between a Portugueſe army of 6000 foot and 1100 horſe, and a Spaniſh army of nearly the ſame number. The latter were entirely defeated; which contributed greatly to eſtabliſh the affairs of Portugal on a firm baſis. The king carried on a defenſive war during the remainder of his life; but after his death, which happened in 1655, the war was renewed with great vigour.

40
Perilous ſtate of Portugal on his death.

This was what the Spaniards did not expect; for they expreſſed a very indecent kind of joy at his death, hoping that it would be followed by a diſſolution of the government. It is not indeed eaſy to conceive a kingdom left in more perilous circumſtances than Portugal was at this time:—The king Don Alonzo Enriquez, a child not more than 13 years of age, reputed of no very ſound conſtitution either in body or mind; the regency in a woman, and that woman a Caſtilian; the nation involved in a war, and this reſpecting the title to the crown; the nobility, ſome of them ſecretly diſaffected to the reigning family, and almoſt all of them embarked in feuds and contentions with each other; ſo that the queen ſcarce knew who to truſt or how ſhe ſhould be obeyed. She acted, however, with great vigour and prudence. By marrying her only daughter the princeſs Catharine to Charles II. King of Great Britain, ſhe procured to Portugal the protection of the Engliſh fleets, with reinforcements of ſome thouſands of horſe and foot; and at laſt, in 1665, terminated the war by the glorious victory of Monteſclaros. This deciſive action broke the power of the Spaniards, and fixed the fate of the kingdom, though not of the king, of Portugal. Alonzo was a prince whoſe education had been neglected in his youth, who was devoted to vulgar amuſements and mean company, and whom the queen for theſe reaſons wiſhed to deprive of the crown, that ſhe might place it on the head of his younger brother Don Pedro. To accompliſh this purpoſe, ſhe attempted every method of ſtern authority and ſecret artifice; but ſhe attempted them all in vain. The Portugueſe would not conſent to ſet aſide the rights of primogeniture, and involve the kingdom in all the miſeries attending a diſputed ſucceſſion. After the death, however, of the queen-mother, the infant entered into cabals againſt the king of a much more dangerous nature than any that ſhe had carried on. Alonzo had married the princeſs of Nemours; but being, as was ſaid, impotent, and likewiſe leſs handſome than his brother, that lady transferred her affection to Don Pedro, to whom ſhe lent her aſſiſtance to hurl the king from the throne. Alonzo was compelled to ſign a reſignation of the kingdom; and his brother, after governing a few months without any legal authority, was in a meeting of the ſtates unanimouſly proclaimed regent, and veſted with all the powers of royalty. Soon after this revolution, for ſuch it may be called, the marriage of the king and queen was declared null by the chapter of Liſbon; and the regent, by a papal diſpenſation, and with the conſent of the ſtates, immediately eſpouſed the lady who had been wife to his brother. He governed, under the appellation of *regent*, 15 years, when, upon the death of the king, he mounted the throne by the title of Don Pedro II. and after a long reign, during which he conducted the affairs of the kingdom with great prudence and vigour, he died on the 19th of December 1706.

41
Don Alonzo obliged to reſign the throne.

42
Don John V. a wiſe and reſolute prince,

Don John V. ſucceeded his father; and though he was then little more than 17 years of age, he acted with ſuch wiſdom and reſolution, adhered ſo ſteadily to the grand alliance formed againſt France and Spain, and ſhowed ſuch reſources in his own mind, that though he ſuffered great loſſes during the war, he obtained ſuch terms of peace at Utrecht, that Portugal was in all reſpects a gainer by the treaty. The two crowns of Spain and Portugal were not, however, reconciled thoroughly till the year 1737; and from this period they became every day more united, which gave much ſatisfaction to ſome courts, and no umbrage to any. In this ſituation of things, a treaty was made in 1750 with the court of Madrid, by which Nova Colonia, on the river of Plata, was yielded to his Catholic majeſty, to the great regret of the Portugueſe, as well on account of the value of that ſettlement, as becauſe they apprehended their poſſeſſion of the Braſils would by this action be rendered precarious. On the laſt of July the ſame year, this monarch, worn out by infirmities, deceaſed, in the 61ſt year of his age, and in the 44th of his reign.

43
Don Joſeph's excellent adminiſtration.

Don Joſeph, prince of Braſil, ſucceeded him, to the univerſal ſatisfaction of his ſubjects, and with as great expectations as ever any monarch that mounted the throne. It was generally believed that he would make conſiderable alterations, in which he did not diſappoint the hopes of the public; and yet they were done ſo ſlowly, with ſuch moderation, and with ſo many circumſtances of prudence, as hindered all grounds of complaint. Amongſt other new regulations, the power of the inquiſition ſuffered ſome reſtriction; the king directing, that none of their ſentences ſhould be put in execution till reviewed and approved by his privy-council. But as in the reign of his father he had conſented to the treaty with Spain, he ratified it after his acceſſion, and ſince carried it into execution upon this noble principle, that no conſiderations of intereſt ought ever to induce a monarch to break his word.

44
Dreadful calamities during his reign.

However, within the ſpace of the few years of this king's reign, the calamities of Portugal in general, and thoſe of the city of Liſbon in particular, cannot, in a great degree, be paralleled in all hiſtory. An earthquake, a fire, a famine, an aſſaſſination-plot againſt their prince, executions upon executions, the ſcaffolds and wheels for torture reeking with the nobleſt blood; imprisonment after impriſonment of the greateſt and moſt diſtinguiſhed perſonages; the expulſion of a chief order of eccleſiaſtics; the invaſion of their kingdom by a powerful, ſtronger, and exaſperated nation; the numerous troops of the enemy laying waſte their territory, bringing fire and ſword with them, and rolling like diſtant thunder towards the gates of their capital; their prince ready almoſt to ſave himſelf by flight! The Spaniſh miniſtry had already decreed the doom of Portugal, and nothing was to be heard at the Eſcurial but *Delenda eſt Carthago.* Carthaginian, perhaps, or Jewiſh ſtory, may poſſibly afford a ſcene ſomething like this, but for the ſhortneſs of the period not ſo big with events, though in their final deſtruction ſuperior. From that indeed, under the hand of Providence, the national humanity and generoſity of Great Britain has preſerved the Portugueſe; and it remains now to be ſeen, in future treaties, how that people will expreſs their gratitude (ſee BRITAIN, n° 450). 45 These calamities fooliſhly accounted for. Thoſe who are able to ſearch deeper into human affairs, may aſſign the cauſes of ſuch a wonderful chain of events; but no wiſe man will aſcribe all this to ſo ſingular a cauſe as that which a Spaniard has done, in a famous pamphlet, printed in the year 1762 at Madrid. It is intitled, *A Spaniſh Prophecy;* and endeavours to ſhow, that all theſe calamities have befallen the Portugueſe, ſolely on account of their connection with the heretic Engliſh. The great Ruler and Governor of the world undoubtedly acts by univerſal laws, regarding the whole ſyſtem, and cannot, without blaſphemy, be conſidered in the light of a partizan. The reſt of the pamphlet tends to ſhow, that his Catholic majeſty carried his arms into Portugal, ſolely to give them liberty, and ſet them free from Engliſh tyranny.

Joſeph dying without male iſſue, the ſucceſſion devolved to Mary, his daughter, now queen of Portugal. She was married ſome time before he died, with the pope's diſpenſation, to his brother Don Pedro.

46 Air, climate, &c. The air of Portugal, in the ſouthern provinces, would be exceſſively hot, if it were not refreſhed by the ſea-breezes; but in the northern, it is much cooler, and the weather more ſubject to rains. The ſpring is extremely delightful here; and the air, in general, more temperate than in Spain. Liſbon has been much reſorted to of late by valetudinarians and conſumptive perſons from Great Britain, on account of its air. The ſoil is very fruitful in wine, oil, lemons, oranges, pomegranates, figs, raiſins, almonds, cheſnuts, and other fine fruits; but there is a want of corn, owing, it is ſaid, in a great meaſure to the neglect of agriculture. There is plenty of excellent honey here; and alſo of ſea and river fiſh, and ſea-ſalt. The horſes in Portugal are briſk lively animals, as they are in Spain, but of a ſlight make: but mules being ſurer-footed, are more uſed for carriage and draught. By reaſon of the ſcarcity of paſture, there are not many herds of cattle or flocks of ſheep; and what they have are ſmall and lean, though the fleſh is tolerably good: their beſt meat is ſaid to be that of hogs and kids. The country in many parts is mountainous: but the mountains contain all kinds of ores; particularly of ſilver, copper, tin, and iron, with a variety of gems, beautifully variegated marble, millſtones, and many curious foſſils. Not far from Liſbon is a mine of ſaltpetre; but none of the metal mines are here worked, the inhabitants being ſupplied with metals of all kinds from their foreign ſettlements. The principal rivers are the Minho, in Latin *Minius;* the Limia, anciently the famed Lethe; the Cavado; the Douro; the Guadiana, anciently Anas; and the Tajo, or Tagus, which is the largeſt river in the kingdom, carrying ſome gold in its ſands, and falling into the ſea a little below Liſbon. There are ſeveral mineral ſprings in the kingdom, both hot and cold, which are much frequented.

47 Religion. The only religion tolerated in Portugal is that of the church of Rome; yet there are many concealed Jews, and thoſe too even among the nobility, biſhops, prebends, monks, and nuns, and the very inquiſitors themſelves. If a Jew pretends to be a Chriſtian and a Roman Catholic, while he is really a Jew, by going to maſs, confeſſion, &c. or if after being converted, or pretending to be converted and pardoned, he relapſes into Judaiſm and is diſcovered, the inquiſition lays hold of him. In the firſt caſe, if he renounce Judaiſm, he is only condemned to ſome corporal puniſhment or public ſhame, and then ordered to be inſtructed in the Chriſtian religion. In the ſecond, he is condemned to the flames without mercy. Beſides Jews and heretics, who broach or maintain any doctrines contrary to the religion of the country, the inquiſition puniſhes all ſodomites, pretenders to ſorcery and the black art, apoſtates, blaſphemers, perjured perſons, impoſters, and hypocrites. The burning of thoſe condemned by the inquiſition, is called an *auto da fe*, or "act of faith." There are ſeveral tribunals of the inquiſition, one of which is at Goa in the Eaſt Indies; but there are none in Braſil. The number of convents in Portugal is ſaid to be 900. The order of Jeſuits hath been ſuppreſſed in this country, as they have been in others. Here is a patriarch, ſeveral archbiſhops and biſhops: the patriarch is always a cardinal, and of the royal family. The archbiſhops rank with marquiſſes, and the biſhops with counts. The Portugueſe have archbiſhops and biſhops in the other quarters of the world as well as in Europe. The ſums raiſed by the popes here, by virtue of their prerogatives, are thought to exceed the revenues of the crown, and the nuncios never fail of acquiring vaſt fortunes in a ſhort time. Though there are two univerſities and ſeveral academies, yet while the papal power, and that of the eccleſiaſtics, continues at ſuch a height, true learning is like to make but a ſmall progreſs. The language of the Portugueſe does not differ much from that of Spain: Latin is the groundwork of both; but the former is more remote from it, and harſher to the ear than the latter. The Portugueſe tongue is ſpoken on all the coaſt of Africa and Aſia as far as China, but mixed with the languages of the ſeveral nations in thoſe diſtant regions.

48 Manufactures. With regard to manufactures, there are very few in Portugal, and thoſe chiefly coarſe ſilks, woollen cloths, and ſome linen; but their foreign trade is very conſiderable, eſpecially with England, which takes a great deal of their wine, ſalt, foreign commodities, and fruits, in return for its woollen manufactures, with which the Portugueſe furniſh their colonies and ſubjects in Aſia, Africa and America. Their plantations in Braſil are very valuable, yielding gold, diamonds, indigo, copper, tobacco, ſugar, ginger, cotton, hides, gums, drugs, dying woods, &c. From their plantations in Africa, they bring gold and ivory, and ſlaves to cultivate their ſugar and tobacco plantations in Braſil. They have ſtill ſeveral ſettlements in the Eaſt Indies, but far leſs conſiderable than formerly. The Azores or Weſtern Iſles, Madeira, and the Cape de Verde iſlands, alſo belong to

them; but a great part of the riches and merchandize brought from theſe diſtant countries becomes the property of foreigners, for the goods they furniſh the Portugueſe with to carry thither. The king's fiſth of the gold brought from Braſil amounts commonly to about 300,000 l. Sterling; ſo that the whole annual produce of gold in Braſil may be eſtimated at near 2,000,000 Sterling. Liſbon is the greateſt port in Europe next to London and Amſterdam.

49 Conſtitution and government.

As to the conſtitution of Portugal, it is an abſolute hereditary monarchy. Both here and in Spain there were anciently cortes, ſtates, or parliaments; but they have long ſince entirely loſt their ſhare in the legiſlature. For the adminiſtration of the civil government, there is a council of ſtate, and ſeveral ſecretaries; for military affairs, a council of war; for the finances, a treaſury court; and for the diſtribution of juſtice ſeveral high tribunals, with others ſubordinate to them, in the ſeveral diſtricts into which the kingdom is divided. The cities have their particular magiſtracy. The proceedings of the courts are regulated by the Roman law, the royal edicts, the canon law, and the pope's mandates. Like the Spaniards, they tranſact moſt of their buſineſs in the mornings and evenings, and ſleep at noon. The nobility are very numerous, and many of them are deſcended from natural ſons of the royal family. They are divided into high and low. The high conſiſts of the dukes, marquiſſes, counts, viſcounts, and barons, who are alſo grandees, but of different claſſes, being ſuffered to be covered in the king's preſence, and having the title of *Dons*, with a penſion from the royal treaſury, to enable them the better to ſupport their dignity: the king ſtyles them *Illuſtrious* in his letters, and treats them as princes. A duke's ſons are alſo grandees, and his daughters rank as marchioneſſes. The inferior nobility or gentry are termed *Hidalgos*, i. e. gentlemen: they cannot aſſume the title of *Don* without the king's licence.

50 Revenues of the king.

The revenues of the crown, ſince the diſcovery of the Braſil mines, are very conſiderable; but the real amount can only be gueſſed at. Some have ſaid that it amounts, clear of all ſalaries and penſions, to upwards of 3,000,000 Sterling; others make it a great deal leſs. Thus much is certain, that the cuſtoms and other taxes run exceſſively high. Beſides the royal demeſnes, the hereditary eſtates of the houſe of Braganza, the monopoly of Braſil ſnuff, the coinage, the money ariſing from the ſale of indulgences granted by the pope, the fiſth of the gold brought from Braſil, the farm of the Braſil diamonds, the maſterſhips of the orders of knighthood, and other ſources, yield very large ſums. The forces, notwithſtanding, of this nation, both by ſea and land, are very inconſiderable; their land-forces being the worſt militia in Europe, and their navy of little importance. They would be an eaſy conqueſt to the Spaniards if they were not under the protection of Britain.

51 Orders of knighthood.

There are ſeveral orders of knighthood here, *viz.* the order of Chriſt, the badge of which is a red croſs within a white one, and the number of the commanderies 454. 2. The order of St James, the badge of which is a red ſword in the ſhape of a croſs. A great number of towns and commanderies belong to this order. 3. The order of Aviz, whoſe badge is a green croſs in form of a lily, and the number of its commanderies 49. Though theſe three ordere are religious, yet the knights are at liberty to marry. 4. The order of St John, which has alſo ſeveral commanderies.

The king's titles are, *King of Portugal and the Algarves, on this ſide and the other ſide the ſea of Africa; Lord of Guinea, and of the navigation, conqueſts, and commerce, in Ethiopia, Arabia, Perſia India*, &c. The king's eldeſt ſon is ſtyled *Prince of Braſil*. In the year 1749, pope Benedict XIV. dignified the king with the title of *His moſt faithful majeſty*.

52 Character of the people.

The Portugueſe are repreſented as inferior to the Spaniards both in perſon and genius: as extremely haughty, treacherous, and crafty in their dealings; much given to avarice and uſury; and vindictive, malicious, and cruel. The meaner ſort are ſaid to be extremely addicted to thieving: notwithſtanding, it muſt be owned, that they have ſhown themſelves on many occaſions a brave and warlike people. They are juſtly famed for their ſkill in navigation; and for the many diſcoveries they have made, both in the Eaſt and Weſt Indies. The women here, and in other countries of the ſame degree of heat, are not ſo prolific as in the colder climates; but they are ſaid to be very beautiful whilſt young, though their complexion is ſomewhat upon the olive. Their eyes are very black and ſparkling, and retain their brilliancy after all their other charms are gone. It is the faſhion here, at preſent, as in moſt other countries, for the ladies to ſpoil and disfigure their ſkins and complexions with paints and waſhes: but, though lively and witty, they are ſaid to have a nice ſenſe of female honour. Both men and women make great uſe of ſpectacles; often not ſo much to aid their ſight, as to denote their wiſdom and gravity. Their dreſs, like that of the Spaniards, never uſed to vary, eſpecially among the men; but of late years, both men and women have given much into the French modes. The women, when they go abroad on foot, are wont to uſe long veils, which cover their heads, but leave their faces bare.

PORTUGALLICA TERRA, earth of Portugal; the name of a fine aſtringent bole, dug in great plenty in the northern part of Portugal.

PORTULACA, PURSLANE: A genus of the monogynia order, belonging to the dodecandria claſs of plants; and in the natural method ranking under the 13th order, *Succulentæ*. The corolla is pentapetalous; the calyx bifid; the capſule unilocular, and cut round. There are ſeveral ſpecies, but the two following are the moſt remarkable. 1. The oleracea, annual, or common culinary purſlane, riſes with herbaceous, low, ſucculent, branchy ſtalks, ſix or eight inches high, garniſhed with wedge-ſhaped, thick, ſucculent leaves, and ſmall cloſe-ſetting flowers. There are two varieties; one with deep green leaves, the other with yellow leaves; both of which riſe from the ſame ſeed. 2. The anacampſeros, perennial, or ſhrubby cape purſlane, riſes with a ſhrubby branchy ſtalk, about ſix inches high, with oval, gibbous, ſucculent leaves, and the ſtalks terminated by ſmall cluſters of red flowers. Both theſe plants are of a ſucculent nature: the firſt is an herbaceous annual, for culinary uſes; and the ſecond a ſhrubby perennial, raiſed by the curious for variety. They are both exotics of a tender quality, of the temperature of greenhouſe or ſtove plants. The common culinary purſlane is raiſed annually from ſeed for ſummer uſe, and is an excellent ingredient in ſummer ſalads, but improper for winter on account of its cold moiſt nature. The plant being tender, muſt be raiſed either on a hot-bed or in a warm border; in which laſt it will not ſucceed before April or May. The ſhrubby ſort muſt be kept in the hot-houſe, in pots of a dry ſoil.

PORTUMNA, a town of Ireland, in the county of Galway and province of Connaught, is 74 miles from Dublin. The caſtle of Portumna, the ſeat of the Earl of Clanricarde, is at this place, and near it are the ruins of an ancient caſtle. There is alſo a garriſon for a troop of horſe and two companies of foot. The town is ſeated on the river Shannon, where it falls into Lough Dreg. The monks of the Ciſtertian abbey of Dunbrody, in the county of Wexford, had for a long time a chapel here, dedicated to St Peter and St Paul; but having at length forſaken it, O'Madden, dynaſt of the country, gave it to the Dominican friars, who, with the approbation of the monks of Dunbrody, erected a friary here and a church, which they dedicated to the bleſſed Virgin and the original patron ſaints; at the ſame time they built a ſteeple, and all other neceſſary offices. Pope Martin V. granted a bull to confirm their poſſeſſions, dated the 8th October 1426; and on the 23d of November following he granted indulgencies to all who had contributed to the building. The walls are ſtill nearly entire, and ſhow that the monaſtery of Portumna was by no means an ignoble ſtructure. The ancient choir is now the pariſh-church.

POSE, in heraldry, denotes a lion, horſe, or other beaſt, ſtanding ſtill, with all his four feet on the ground. See Hollingſhead's *Deſcription of Britain*, chap. xvi.

POSITIVE, a term of relation oppoſed to negative. It is alſo uſed in oppoſition to relative or abitrary: thus we ſay, Beauty is no poſitive thing, but depends on the different taſtes of people.

Positive Degree, in grammar, is the adjective in its ſimple ſignification, without any compariſon.

Positive Electricity. In the Franklinian ſyſtem all bodies ſuppoſed to contain more than their natural quantity of electric matter are ſaid to be *poſitively* electrified; and thoſe from whom ſome part of the electricity is ſuppoſed to be taken away are ſaid to be electrified *negatively*. Theſe two electricities being firſt produced, one from glaſs, the other from amber or roſin, the former was called *vitreous*, the other *reſinous*, electricity.

POSPOLITE, in the military eſtabliſhment of Poland, is the name given to a kind of militia. It is the moſt numerous and the moſt uſeleſs of the Poliſh armies. It conſiſts of the gentry at large, who, in caſe of invaſion, are aſſembled by a regular ſummons from the king, with conſent of the diet. Every palatinate is divided into diſtricts, over each of which proper officers are appointed; and every perſon poſſeſſing free and noble tenures is bound to military ſervice, either ſingly or at the head of a certain number of his retainers, according to the extent and nature of his poſſeſſions. The troops thus aſſembled are obliged only to ſerve for a limited time, and are not under the neceſſity of marching beyond the limits of their country. They ſubmit to no diſcipline but ſuch as they like themſelves; and are very apt to mutiny if detained more than a fortnight in the place appointed them to meet in, without marching. The mode of levying and maintaining this army is exactly ſimilar to that practiſed under the feudal ſyſtem. At preſent, though it is almoſt totally unfit for the purpoſes of repelling a foreign enemy, it is yet a powerful inſtrument in the hands of domeſtic faction: for the expedition with which it is raiſed under the feudal regulations facilitates the formation of thoſe dangerous confederacies which ſuddenly ſtart up on the conteſted election of a ſovereign, or whenever, the nobles are at variance with each other.

Coxe's Travels.

POSSE COMITATUS, in Engliſh law, ſignifies the power of the county, or the aid and aſſiſtance of all the knights, gentlemen, yeomen, labourers, ſervants, apprentices, &c. and all others within the county that are above the age of 15, except women, eccleſiaſtical perſons, and ſuch as are decript and infirm.

This poſſe comitatus is to be raiſed where a riot is committed, a poſſeſſion kept upon a forcible entry, or any force of reſcue uſed contrary to the king's writ, or in oppoſition to the execution of juſtice; and it is the duty of all ſheriffs to aſſiſt juſtices of the peace in the ſuppreſſion of riots, &c. and to raiſe the poſſe comitatus, or to charge any number of men for that purpoſe.

POSSESSION, in law, is either actual, where a perſon actually enters into lands or tenements deſcended or conveyed to him; or where lands are deſcended to a perſon, and he has not yet entered into them. A long poſſeſſion is much favoured by the law as an argument of right, even though no deed can be ſhown, and it is more regarded than an ancient deed without poſſeſſion.

If he that is out of poſſeſſion of land brings an action, he muſt prove an undeniable title to it; and when a perſon would recover any thing of another, it is not ſufficient to deſtroy the title of the perſon, in poſſeſſion without he can prove that his own right is better than his.

In order to make poſſeſſion lawful upon an entry, the former poſſeſſor and his ſervants are to be removed from off the premiſſes entered on: but a perſon by leaſe and releaſe is in poſſeſſion without making any entry upon the lands.

POSSESION, in Scots law. See LAW, Part III. Nº clxii. 11, &c.

Dæmoniacal POSSESSION. (See DÆMON and DÆMONIACS.) In the third volume of the Mancheſter Tranſactions, there is a paper on *popular illuſions* or medical demonology by Dr Ferriar. He informs us in a note, that, on the 13th of June 1788, George Lukins of Yatton in Somerſetſhire was exorciſed in the temple church at Briſtol, and delivered from the poſſeſſion of ſeven devils by the efforts of ſeven clergymen. An account of his deliverance was publiſhed in ſeveral of the public papers, authenticated by the Reverend Mr Eaſterbrook, vicar of the temple church in Briſtol.—Dr Ferriar gives us the following particulars, extracted from this account, which we ſhall here inſert.

"Lukins was firſt attacked by a kind of epileptic fit, when he was going about acting Chriſtmas plays, or mummeries: this he aſcribed to a blow given by an inviſible hand. He was afterwards ſeized by fits; during which he declared, with a roaring voice, that he was the devil, and ſung different ſongs in a variety of keys. The fits always began and ended with a ſtrong agitation of the right hand. He frequently uttered dreadful execrations during the fits. The whole duration of his diſorder was eighteen years.

"At length, viz. in June 1788, he declared that he was poſſeſſed by ſeven devils, and could only be freed by the prayers *(in faith)* of ſeven clergymen. Accordingly the requiſite force was ſummoned, and the patient ſung, ſwore, laughed, and barked, and treated the company with a ludicrous parody on the *Te Deum.* Theſe aſtoniſhing ſymptoms reſiſted both hymns and prayers, till a *ſmall, faint, voice* admoniſhed the miniſters to adjure. The ſpirits, after ſome murmuring, yielded to the adjuration, and the happy patient returned thanks for his wonderful cure. It is remarkable that during this ſolemn mockery, the fiend ſwore 'by his infernal den,' that he would not quit his patient; an oath, I believe, no where to be found but in the Pilgrim's progreſs, from which Lukins probably got it.

"Very ſoon after the firſt relation of this ſtory was publiſhed, a perſon, well acquainted with Lukins, took the trouble of undeceiving the public with regard to his pretended diſorder, in a plain, ſenſible narrative of his conduct. He aſſerts, that Lukins's firſt ſeizure was nothing elſe than a fit of drunkenneſs; that he always foretold his fits, and remained ſenſible during their continuance; that he frequently ſaw Lukins in his fits, 'in every one of which, except in ſinging, he performed not more than moſt active young people can eaſily do; that he was detected in an impoſture with reſpect to the clenching of his hands; that after money had been collected for him, he got very ſuddenly well; that he never had any fits while he was at St George's Hoſpital in London; nor when viſitors were excluded from his lodgings, by deſire of the author of the Narrative; and that he was particularly careful never to hurt himſelf by his exertions during the paroxyſm.

"Is it for the credit of this philoſophical age, that ſo bungling an impoſture ſhould deceive ſeven clergymen into a public act of exorciſm? This would not have paſſed even on the authors of the *Malleus Maleficarum*; for they required ſigns of ſupernatural agency, ſuch as the ſuſpenſion of the poſſeſſed in the air, without any viſible ſupport, or the uſe of different languages, unknown to the demoniac in his natural ſtate."

POSSESSIVE, in grammar, a term applied to pronouns which denote the enjoyment or poſſeſſion of any thing either in particular or in common: as *meus*, "mine;" and *tuus*, "thine."

POSSESSORY ACTION, in Scots Law. See LAW, nº clxxxiii. 18.

POSSIBILITY, in law, is defined to be any thing that is altogether uncertain, or what may or may not be.

POSSIBILITY, alſo denotes a non-repugnance to exiſting, in any thing that does not any way exiſt.

POSSIBLE, is ſometimes oppoſed to real exiſtence, and is underſtood of a thing, which, though it actually does not exiſt, yet may exiſt; as a new ſtar.

POSSIDONIA, (anc. geog.) See POESTUM.

POST, a word derived from the Latin *poſitus*, "ſet or placed." It is uſed in ſeveral different meanings, but all of them referring either immediately or remotely to this primitive ſenſe of *poſition*. Thus the word Poſt ſignifies, 1. A ſtake or piece of timber ſet upright; 2. A ſtation, particularly a military ſtation; 3. An office or employment; 4. An operation in book-keeping; 5. A conveyance for letters or diſpatches; 6. A particular mode of travelling.

POST, a ſtake or piece of timber ſet upright. Poſts are uſed both in building and in fencing ground. In brick-buildings much of the ſtrength of the fabric depends on the nature of the poſts; as it is through them that the ſeveral parts are ſuſtained and held together. The *corner poſts* are called the *principal poſts*; thoſe formed into breſſummers between principal poſts for ſtrengthening the carcaſe of the houſe are called the *prick-poſts*. Poſts which are to be ſet in the ground ought to be well ſeaſoned and coated to preſerve them from rotting; burning the downward end has been recommended as an excellent preſervative, but a coating of pitch or tar, particularly the late invented coal-tar, can be moſt ſafely relied upon. For the various uſes to which poſts may be applied, and the form and ſpecies of them fitteſt to be employed in each caſe, ſee the articles ARCHITECTURE, JOINING, GARDENING, HOUSE, FENCE, &c. In architecture and ſculpture POSTS is a term uſed to denote certain ornaments formed after the manner of rolls or wreathings.

POST, a ſtation, particularly a military ſtation.—Any place where perſons are ſet or placed upon particular occaſions may be termed a *poſt*; but the word in this view is now chiefly reſtricted to military operations, and means any place or ſituation where ſoldiers are ſtationed. Thus the detachments eſtabliſhed in front of the army are termed the *out-poſts*, the ſtations on the wings of the army are ſaid to be the *poſts of honour*, as being the moſt conſpicuous and moſt expoſed. But in the operations of a campaign, a poſt properly ſignifies any ſpot of ground capable of lodging ſoldiers, or any ſituation, whether fortified or not, where a body of men may make a ſtand and engage the enemy to advantage. The great advantages of good poſts, in carrying on war, as well as the mode of ſecuring them, are only learned by experience. Barbarous nations diſdain the choice of poſts, or at leaſt are contented with ſuch as immediately fall in their way; they truſt ſolely or chiefly to ſtrength and courage: and hence the fate of a kingdom may be decided by the event of a battle. But enlightened and experienced officers make the choice of poſts a principal object of attention. The uſe of them is chiefly felt in a defenſive war againſt an invading enemy; as by carrying on a war of poſts in a country where this can be done to advantage, the moſt formidable army may be ſo haraſſed and reduced, that all its enterpriſes may be rendered abortive. Indeed in modern times this is ſo well underſtood, that pitched battles have become much more rare than formerly, manœuvring and ſecuring of poſts being conſidered as the moſt eſſential objects in the conduct of a campaign; a change in the art of war much to the advantage of humanity; ſkill, conduct, and prudence, having thus obtained the aſcendency over brutal courage and mere bodily ſtrength. In the choice of a poſt, the general rules to be attended to are, that it be convenient for ſending out parties to reconnoitre, ſurpriſe, or intercept the enemy; that if poſſible it have ſome natural defence, as a wood, a river, or a moraſs, in front or flank, or at leaſt that it be difficult of acceſs and ſuſceptible of ſpeedy fortification; that it be ſo ſituate as to preſerve a communication with the main army, and have covered places in the rear to favour a retreat; that it command a view of all the approaches to it, ſo that the enemy cannot advance unperceived and reſt concealed, while the detachment ſtationed in the poſt are forced to remain under arms; that it be not commanded by any neighbouring heights; and that it be proportioned in extent to the number of men who are to occupy and defend it. It is not to be expected that all theſe advantages will often be found united; but thoſe poſts ought to be ſelected which offer the greateſt number of them. See War, *Index*.

Post, an office or employment. This uſe of the word is probably derived immediately from the idea of a military ſtation; a poſt being uſed to expreſs ſuch offices or employments as are ſuppoſed either to expoſe the holder to attack and oppoſition, or to require abilities and exertion to fill them. Hence the term is uſed only for *public* offices, and employments under the government; and were ſtrict propriety of ſpeech always attended to, *poſts* would denote thoſe ſtations only in which duty muſt be performed. In common language, however, every *public* office or appointment, even though nominal and ſinecure, goes under the name of a *poſt*.

Post, an operation in book-keeping. Poſting in book-keeping means ſimply the transferring an article to the place in which it ſhould be put, and arranging each under its proper head. It is upon this that the whole theory of book-keeping is founded. The Waſte-book, which is the groundwork of all ſubſequent operations, records every tranſaction exactly in the order in which it occurs. From this the ſeveral articles are poſted, or transferred into the Journal, which in fact is but a kind of ſupplementary book to the Waſte-book. From the Journal they are poſted anew into the Ledger; in which a ſeparate place is appropriated for each perſon with whom tranſactions are carried on, and frequently for every ſeparate article about which the buſineſs is concerned. The particular mode according to which ſuch transferences are made, may vary according to the nature of the trade carried on; the object is the ſame in all, to place every article ſo as that its operations on the general ſtate of the buſineſs may be certainly known and diſtinctly traced. For a full account of the way in which this is done, ſee *Book-Keeping*.

Post, a conveyance for letters or diſpatches.

In the early periods of ſociety, communication between the different parts of a country is rare and difficult, individuals at a diſtance having little inclination or opportunity for mutual intercourſe: when ſuch communication is at any time found neceſſary, a ſpecial meſſenger muſt be employed. As order and civilization advance, occaſions of correſpondence multiply. In particular, the government finds it requiſite frequently to tranſmit orders and laws to every part of the country; and for doing ſo he makes uſe of couriers or meſſengers, to whom he commits the charge of forwarding his diſpatches. But without ſtations in the way, where theſe couriers can be certain of finding refreſhment for themſelves and ſupplies of what may be neceſſary for carrying them forward, the journey, however urgent and important, muſt always be retarded, and in many caſes altogether ſtopped. Experience, therefore, ſoon pointed out the neceſſity of enſuring ſuch accommodations, by erecting upon all the great roads houſes or ſtations at convenient intervals, where the meſſengers might ſtop, as occaſion required, and where too, for the greater convenience, relays of freſh horſes ſhould always be in readineſs, to enable them to purſue their journey with uninterrupted diſpatch. Theſe houſes or ſtations were with great propriety termed *poſts*, and the meſſenger who made uſe of them a *poſt*. Though at firſt, it is probable, the inſtitution was intended ſolely for the government and the neceſſities of the ſtate; yet by degrees individuals, ſeeing the benefit reſulting from it, made uſe of the opportunity to carry on their own correſpondence; for which they were willing to pay an allowance to the government. Thus a poſt-office, of ſome kind or other, gradually came to be eſtabliſhed in every civilized country. Without taking notice of the different means of carrying on correſpondence ſaid to have been attempted by pigeons, dogs, and other animals, we can at leaſt trace with certainty the invention of ſomething like regular poſts as far back as the ancient Perſians. Xenophon aſſures us, that they were invented by Cyrus on his Scythian expedition, about 500 years before Chriſt; that the houſes at the ſeveral ſtations were ſumptuouſly built, and large enough to contain a number of men and horſes; and that every courier on his arrival was obliged to communicate his diſpatches to the poſtmaſter, by whom they were immediately forwarded. From the ſhore of the Egean ſea to Suſa the capital, there were, according to Herodotus, 111 ſtages for poſts, each a day's journey diſtant from the preceding.

In what manner poſts were eſtabliſhed and conducted among the Greeks does not clearly appear; but from the extended commerce carried on, and the frequent communications enjoyed among the different ſtates, there can be no doubt that a regular conveyance, in ſome form or other, was eſtabliſhed.

Though poſts were well known among the Romans, yet it is difficult to trace with certainty the period of their introduction. Some writers carry it back to the times of the republic; poſts and poſt-offices, under the names of *ſtatores* and *ſtationes*, having been then, it is ſaid, eſtabliſhed by the ſenate. Whether this was the caſe or not, Suetonius aſſures us that Auguſtus inſtituted poſts along all the great roads of the empire. At firſt the diſpatches were conveyed from poſt to poſt by young men who run on foot, and delivered the diſpatch to others at the next ſtage. By and by Auguſtus ſubſtituted, in room of theſe, horſes and chariots, both for the conveyance of diſpatches and the convenience of travelling. His ſucceſſors continued the ſame eſtabliſhment; to the maintenance of which every ſubject of the empire was obliged to contribute. Poſt-horſes are mentioned in the Theodorian code *de curſu publico*; but theſe were only the public horſes appointed to be kept there for the uſe of the public meſſengers, who before this inſtitution ſeized any that came in their way. At each poſt-ſtation, according to Procopius, 10 horſes and as many poſtilions were kept, and the uſual rate of their travelling was from five to eight ſtations a-day.

It is to be obſerved, however, that all theſe eſtabliſhments of poſts in ancient times were formed as much, if not more, for travelling ſtations, than for the mere conveyance of letters and diſpatches. This latter object, it is true, was thereby ſecured; but the epiſtolary correſpondence of antiquity was probably at no time ſo extenſive as to require or maintain poſt-offices on the footing of modern poſts, for the mere conveyance of letters. It is in later times only when the extenſion of commerce and diffuſion of literature gave occaſion to frequent communication, that theſe eſtabliſhments are to be looked for.

The earlieſt inſtitution of *poſts* that occurs in modern hiſtory is about the year 807 by the emperor *Charlemagne;* who, having reduced under his dominion Italy, Germany, and a part of Spain, eſtabliſhed three public poſts at the public expence, to carry on the communication with theſe three provinces. The inſtitution of poſts, however, like many other inſtitutions of that emperor, dropped at his death, and for a conſiderable time afterwards no traces of any ſuch eſtabliſhment are to be found. We cannot indeed diſcover them with certainty ſooner than 1464, when that reſtleſs and ſuſpicious prince Louis XI. eſtabliſhed poſts in France, that he might be the ſooner advertiſed of all that paſſed in his own or the neighbouring kingdoms. He employed in this ſervice 230 couriers, who delivered the letters at the different ſtations, and in the various towns through which they paſſed in their courſe. Succeeding monarchs created at different times certain offices for the expreſs purpoſe of ſuperintending the poſts; but the frequent changes to which theſe offices were expoſed, prevented for a long time the eſtabliſhment of any regular ſyſtem of poſts in that kingdom; inſomuch that in 1619 the author of the life of the duke d'Epernon ſays the packet or letter-office was not yet ſet up in France. Former eſtabliſhments, it is probable, were ſolely for the uſe of the court, not for the general good of the nation. From France, the inſtitution gradually ſpread through ſeveral other parts of Europe. In Germany, Lewis Hornig aſſures us they were firſt introduced by Count Taxis, who ſettled them at his own expence; in acknowledgment for which the Emperor Matthias in 1616 gave as a fief the office of poſtmaſter to him and his deſcendants.

In England, the eſtabliſhment of poſts in ſome form or other appears as early as the reign of Edward III. but the notices concerning them are ſo vague, that no account can be given of them. In the reign of Edward VI. however, ſome ſpecies of poſts muſt have been ſet up, as an act of parliament paſſed in 1548, fixing the rate of poſt-horſes at one penny *per* mile: The poſt-horſes here referred to were, it is probable, chiefly for travelling, and the carriage of letters or packets only an occaſional ſervice. In 1581, we find in Cambden's Annals mention made of a chief poſtmaſter for England being appointed.—How this office was managed, does not clearly appear; the limited ſtate of the correſpondence of the country, probably rendered it of trifling conſequence. King James I. originally erected a poſt-office, under the controul of one Matthew de Queſter or de l'Equeſter, for the conveyance of letters to and from foreign parts; which office was afterwards claimed by Lord Stanhope; but was confirmed and continued to William Frizel and Tho. Witherings, by king Charles I. in 1632. Previous to this time, it would appear that private perſons were in uſe to convey letters to and from foreign parts; all ſuch interference with the poſtmaſter's office is therefore expreſsly prohibited. King Charles, in 1635, erected a letter-office for England and Scotland, under the direction of the above Thomas Witherings. The rates of poſtage then eſtabliſhed were, two-pence for every ſingle letter for a diſtance under 80 miles; four-pence from 80 to 140 miles; ſix-pence above 140 miles. The allowance to the poſtmaſters on the road for horſes employed in theſe poſts was fixed at two-pence halfpenny *per* mile for every ſingle horſe. All private inland poſts were diſcharged at this time; and in 1637 all private foreign poſts were in like manner prohibited. The poſts thus eſtabliſhed, however, extended only to a few of the principal roads; and the times of tranſmiſſion were not in every caſe ſo certain as they ought to have been.

Witherings was ſuperſeded for abuſes in the execution of his offices in 1640, and they were ſequeſtrated into the hands of Philip Burlamachy, to be exerciſed under the care and overſight of the king's principal ſecretary of ſtate. On the breaking out of the civil war, great confuſions and interruptions were neceſſarily occaſioned in the conduct of the letter-office: but it was about that time that the outline of the preſent more extended and regular plan ſeems to have been conceived by Mr Edmond Prideaux, who was afterwards appointed attorney-general to the commonwealth. He was chairman of a committee in 1642 for conſidering the rate of poſtage to be ſet upon inland letters; and ſome time after was appointed poſtmaſter by an ordinance of both houſes of parliament; in the execution of which office he firſt eſtabliſhed a *weekly* conveyance of letters into *all* parts of the nation. In 1653, this revenue was farmed for L. 10,000 for England, Scotland, and Ireland; and after the charge of maintaining poſtmaſters, to the amount of L. 7000 *per annum*, was ſaved to the public. Prideaux's emoluments being conſiderable, the common council of London endeavoured to erect another poſt-office in oppoſition to his; but they were checked by a reſolution of the houſe of commons declaring that the office of poſtmaſter is, and ought to be, in the ſole power and diſpoſal of the parliament. This office was farmed by one Maubey in 1654. In 1656 a new and regular general poſt-office was erected by the authority of the protector and his parliament, upon nearly the ſame model that has been ever ſince adopted, with the following rates of poſtage: For 80 miles diſtance, a ſingle letter two-pence; for a greater diſtance, not out of England, three-pence; to Scotland, four pence. By an act of parliament paſſed ſoon after the reſtoration in 1660, the regulations ſettled in 1656 were re-eſtabliſhed, and a general poſt-office ſimilar to the former, but with ſome improvements, was erected. In 1663 the revenue of the poſt-office was found to produce L. 21,500 annually. In 1685 it was made over to the king as a branch of his private income, and was then eſtimated at L. 65,000 *per annum*. The year after the revolution the amount of the poſt-office revenue was L. 90,504 : 10 : 6. At the union the produce of the Engliſh poſt-office was ſtated to be L. 101,101. In 1711 the former eſtabliſhments of ſeparate poſt-offices for England and Scotland were aboliſhed; and by the ſtat. 9 Anne, c. 10. one general poſt-office, and one poſtmaſter-general, were eſtabliſhed for the whole united kingdom; and this poſtmaſter was empowered to erect chief letter-offices at *Edinburgh*, at

Dublin at *New York*, and other proper places in America and the Weſt Indies. The rates of poſtage were alſo increaſed at this time as follows.—In England, for all diſtances under 80 miles 3 d.; above 80 miles 4 d. From London to Edinburgh 6 d. In Scotland, under 50 miles 2 d.; from 50 to 80 miles 3 d.; above 80 miles 4d. In Ireland, under 40 miles 2 d.; above 40 miles 4d.—By the above act all perſons, except thoſe employed by the poſtmaſter, were ſtrictly prohibited from conveying letters. That year the groſs amount of the poſt-office was L 111,561 17s 10d. The nett amount, on a medium, of the three preceding years, was, in the printed report of the commiſſioners, for the equivalent ſtated to be for England, L 62,000, and for Scotland L. 2000. In 1754 the groſs revenue of the poſt-office for Great Britain amounted to L. 210,663, in 1764 to L. 281,535, and in 1774 to L. 345,321.—The privilege of franking letters had been enjoyed by members of parliament from the firſt erection of the poſt-office; the original deſign of this exemption was, that they might correſpond freely with their conſtituents, on the buſineſs of the nation. By degrees the privilege came to be ſhamefully abuſed, and was carried ſo far, that it was not uncommon for the ſervants of members of parliament to procure a number of franks for the purpoſe of ſelling them; an abuſe which was eaſily practiſed, as nothing more was required for a letter's paſſing free than the ſubſcription of a member on the cover. To reſtrain theſe frauds, it was enacted, in 1764, that no letter ſhould paſs free unleſs the whole direction was of the member's writing, and his ſubſcription annexed. Even this was found too great a latitude; and by a new regulation in 1784, no letter was permitted to go free unleſs the date was marked on the cover in the member's own hand-writing, and the letter put into the poſt-office the ſame day. That year the rates of poſtage were raiſed in the following proportions: an addition of 1 d. for a ſingle ſtage; 1 d. from London to Edinburgh; 1 d. for any diſtance under, and 2 d. for any diſtance above, 150 miles. An addition to the revenue of L. 120,000 was eſtimated to ariſe from theſe regulations and additional rates. In all the ſtatements of duties upon poſtage of letters given in this account, the rates mentioned are thoſe upon ſingle letters, double letters pay double, treble letters treble, an ounce weight quadruple poſtage; all above are charged by the weight in the ſame proportion.

About the year 1784, a great improvement was made in the mode of conveying the mails, upon a plan firſt ſuggeſted in 1782 by Mr John Palmer. Diligences and ſtage coaches, he obſerved, were eſtabliſhed to every town of note in the kingdom; and he propoſed that government, inſtead of ſending the mails in the old mode, by a boy on horſeback, ſhould contract with the maſters of theſe diligences to carry the mail, along with a guard for its protection. This plan, he ſhowed, could not fail to enſure much more expeditious conveyance, the rate of travelling in diligences being far quicker than the rate of the poſt; and it was eaſy to carry it into execution with little additional expence, as the coach owners would have a ſtrong inducement to contract at a cheap rate for conveying the mail, on account of the additional recommendation to paſſengers their carriages would thereby acquire in point of ſecurity, regularity, and diſpatch.

Tho' government heartily approved of this plan, and the public at large were ſatisfied of its utility; yet, like all new ſchemes, however beneficial, it met with a ſtrong oppoſition: it was repreſented by a number of the oldeſt and ableſt officers in the poſt-office, not only as impracticable, but dangerous to commerce and the revenue. Notwithſtanding of this oppoſition, however, it was at laſt eſtabliſhed, and gradually extended to many different parts of the kingdom; and, upon a fair compariſon, it appeared that the revenue was improved, and the plan itſelf executed for L. 20,000 *per annum* leſs than the ſum firſt eſtimated by Mr Palmer.

The preſent eſtabliſhment of the general poſt office for Great Britain, conſiſts of two poſtmaſters-general, a ſecretary, ſurveyor, comptrolier-general, and upwards of 150 aſſiſtants and clerks for the head letter office in London; the number of deputy poſtmaſters and other officers through the kingdom is very conſiderable, but not eaſy to aſcertain with accuracy, as it muſt frequently vary with the changes made in the eſtabliſhment of country poſts. The total expence of this branch of the revenue in 1788 was L. 149,029, 17 s. 2 d. the groſs produce may now be reckoned at L. 650,000.

The firſt accounts we have of the eſtabliſhment of a poſt-office in Scotland reach no farther back than 1635, when Charles I. erected one both for Scotland and England. The poſt to Scotland by that appointment was to run night and day, to go from London to Edinburgh and to return in *ſix* days, taking with it all letters intended for any poſt-town in or near the road; the rate of poſtage from London to Edinburgh was 8 d. for a ſingle letter. The expedition with which the poſt went from London to Edinburgh at this time, is indeed ſurpriſing, conſidering the nature of the roads; perhaps, however, though the king made the regulation that it ſhould go and return in ſix days, the journey was not always performed in the ſpecified time. During the government of Cromwell, the public poſt conveyed letters to Scotland as well as England; the poſtage from London to Scotland was only 4 d. After the Reſtoration, when the poſt-office was erected for England, mention is made in the act of parliament of the conveyance of letters to Scotland; and the poſtage to Berwick is fixed at 3d. For ſome time after, however, we find no eſtabliſhment by act of parliament of an internal poſt in Scotland. In 1662, a poſt between Ireland and Scotland was firſt eſtabliſhed; and the privy council gave Robert Main, who was then poſtmaſter-general for Scotland, an allowance of L. 200 Sterling to build a packet-boat for conveying the mail between Portpatrick and Donaghade: the poſtage to Ireland was 6d. In 1669, a poſt was eſtabliſhed to go between Edinburgh and Aberdeen twice a-week, and between Edinburgh and Inverneſs once a-week: the rate of poſtage was fixed, for 40 Scots miles 2d. and for every 20 miles farther an additional penny. Theſe appear to have been the only *public* poſts in Scotland at that time; but as they could not ſuffice for the correſpondence of the country, there muſt have been more, either under the direction of the poſtmaſter, or in the hands of private perſons; probably there might be of both kinds. In 1690, an act for the ſecurity of the common poſt was paſſed, ſubjecting robbers of the mail to capital puniſhment. It was not till 1695 that the eſtabliſhment of the poſt-office in Scotland received the ſanction of parliament: poſts were then appointed for all parts of Scotland; the rates of poſtage were fixed, for any place within 50 miles of Edinburgh 2 d. between 50 and 100 miles 3 d. all places above 100 miles 4 d. By the ſame act, a weekly packet to Ireland was eſtabliſhed, and L. 60 Sterling annually allowed for that ſervice. Though poſts were eſtabliſhed in conſequence of this act, yet ſuch was their mode of travelling, that they hardly deſerved the name. Thus, for inſtance, the perſon who ſet out to carry the mail from Edinburgh to Aberdeen, in place of ſtopping at the firſt intermediate ſtage from Edinburgh, and delivering over the mail to another, to be carried forward, went on with it himſelf the whole journey, reſting two nights by the way, firſt at Dundee, and next at Montroſe.

In this manner the mail was conveyed thrice a-week from Edinburgh to Aberdeen; but between moſt parts of Scotland the poſt went only twice, and between ſome only once a-week. The poſt-boy generally travelled on foot. Horſes were but little uſed in the ſervice of the poſt-office.

At the Union, the Scots poſt office was farmed for L. 1194: in 1710, the nett amount for Scotland was reckoned to be L. 2000. The epiſtolary correſpondence of Scotland muſt have been ſmall indeed, when even the rates of poſtage then eſtabliſhed proved ſo very unproductive. This may perhaps, however, be in part accounted for, by conjecturing, that as private poſts had probably prevailed pretty much before 1695, it was long before theſe were entirely ſuppreſſed, the people ſtill adhering to their old conveyances, and difficulties occurring in ſtrictly enforcing the law; the amount of the poſt-office revenue, therefore, at the two periods abovementioned probably exhibits a view of only a part of the correſpondence of Scotland.

In 1711, it has been already mentioned, one general poſt-office was eſtabliſhed for the whole united kingdom; but the poſtmaſter-general was authoriſed to erect at Edinburgh a chief letter office for Scotland.— This was accordingly done, and a poſtmaſter-general for North Britain, with other neceſſary officers, appointed. All the deputy poſtmaſters in Scotland are under his immediate direction, but he himſelf is under the controul of the poſtmaſter-general for Great Britain. From this head letter office poſts were eſtabliſhed to the different parts of Scotland.

For many years the poſt-boys generally travelled on foot, or if on horſeback, without a change of horſes. It was not till about 1750 that the mail began to be conveyed from ſtage to ſtage by different poſt-boys and freſh horſes to the principal places in Scotland, and by foot runners to the reſt. The communication between London and Edinburgh was at firſt but thrice a-week, and ſo ſlow, that the mail from London to Edinburgh was upon the road 85 hours, and from Edinburgh to London 131 hours. In 1757, upon a repreſentation from the royal boroughs, regulations were fallen upon, by which the time was ſhortened to 82 hours in the one caſe, and 85 in the other. By the extenſion of Mr Palmer's plan to Scotland, the time has been ſtill farther ſhortened to about 60 hours in each caſe.

The eſtabliſhment of the Scots poſt-office, which has been gradually enlarged as the ſtate of the country required, conſiſts at preſent of a poſtmaſter-general, ſecretary, ſolicitor, and accountant, with a number of other clerks and aſſiſtants for the head office at Edinburgh; under its management are about 180 deputy-poſtmaſters for the different poſt-towns through Scotland.

The nett produce of the poſt-office for Scotland in 1733 was L.5399, in 1754 L.8927, in 1757 L.10,623, in 1760 L.11,942, in 1776 L.31,103. In 1788 the groſs produce was L.55,836, the expence L.22,636, 13 s. 6 d.: in 1793 the groſs amount was about L.64,000, the nett produce about L.40,000.

Penny-Post, a poſt eſtabliſhed for the benefit of London and other parts adjacent, whereby any letter or parcel under 16 ounces weight, or L.10 value, is ſpeedily and ſafely conveyed to and from all places within the bills of mortality, or within 10 miles of the city. It is managed by particular officers, and receiving houſes are eſtabliſhed in moſt of the principal ſtreets, for the more convenient tranſmiſſion of the letters. Some other large towns have inſtituted ſimilar eſtabliſhments.

About 20 years ago a penny-poſt was ſet up in Edinburgh by an individual, unconnected with the general poſt-office. It met with but indifferent encouragement for ſome years, doubts being entertained as to its punctuality in delivering the letters; by degrees, however, it ſeemed to be advancing in eſtimation, and was more frequently employed. About a year ago, the general poſt-office, in virtue of the act of parliament prohibiting the conveyance of letters by any but thoſe employed under the poſtmaſter-general, took the penny-poſt entirely into its own hands; and at preſent letters are tranſmitted from the general poſt-office to the different quarters of Edinburgh and the ſuburbs, three or four times a-day.

Post, a particular mode of travelling. A perſon is ſaid to *travel poſt*, in contradiſtinction to common journey travelling, when, in place of going on during his whole journey in the ſame vehicle, and with the ſame horſes, he ſtops at different ſtages, to provide freſh horſes or carriages for the ſake of greater convenience and expedition. As he thus uſes the ſame mode of travelling that is employed for the common poſt, he is ſaid to travel poſt, or in poſt, *i. e.* in the manner of a poſt.

In tracing the origin of poſts, it has been already remarked, that the more ancient eſtabliſhments of this kind were fully as much for *travelling ſtations* as the conveyance of letters. The relays of horſes provided at theſe public ſtations for the meſſengers of the prince, were occaſionally, by ſpecial licence, allowed to be uſed by other travellers who had ſufficient intereſt at court. Frequent demands of this nature would ſuggeſt the expedient of having in readineſs ſupplies of freſh horſes or carriages over and above what the *public* ſervice required, to be hired out to other travellers on payment of an adequate price. We find, therefore, that in former times the poſtmaſters alone were in uſe to let out horſes for riding poſt, the rates of which were fixed in 1548 by a ſtatute of Edward VI. at one penny *per* mile. In what ſituation the ſtate of the kingdom was with regard to travelling poſt for more than a century after this period, we cannot now certainly diſcover; but in the ſtatute re-eſtabliſhing the poſt-office in 1660, it is enacted, that none but the poſtmaſter, his deputies, or aſſigns, ſhall furniſh poſt-horſes for travellers; with a proviſo, however, that if he has them not ready in half an hour after being demanded, the traveller ſhall be at liberty to provide himſelf elſewhere.

The ſame prohibition is contained in the act eſtabliſhing the Scots poſt-office in 1695, as well as in the ſubſequent act of Queen Anne, erecting the general office for the united kingdom. It is doubtful, however, whether it ever was ſtrictly enforced. By an explanatory act of 26 Geo. II. the prohibition is confined to poſt *horſes* only, and every perſon declared to be at liberty to furniſh *carriages* of every kind for riding poſt. This regulation has, in fact, done away the prohibition, as hardly any perſon now thinks of travelling poſt except in a carriage.

The rate fixed by the act 1695, in Scotland, for a horſe riding poſt, was three-pence *per* Scotch mile. By the act 9 Anne, c. 10. three-pence a-mile without, and four-pence a-mile with, a guide, was the ſum fixed for each horſe riding poſt. The increaſe of commerce, and neceſſity for a ſpeedy communication between different parts of the kingdom, have brought the mode of travelling poſt ſo much into uſe, that upon every great road in the kingdom poſt-chaiſes are now in readineſs at proper diſtances; and the convenience of poſting is enjoyed in Britain to a degree far ſuperior to what is to be met with in any other country whatever.

Poſting at laſt appeared to the legiſlature a proper object of taxation. In 1779 the firſt act was paſſed, impoſing duties on horſes hired either by themſelves or to run in carriages travelling poſt: the duties were, one penny *per* mile on each horſe if hired by the mile or ſtage, and one ſhilling *per* day if hired by the day. Every perſon letting out ſuch horſes was alſo obliged to take out a licence at five ſhillings *per annum*. Theſe duties were next year repealed, and new duties impoſed, of one penny *per* mile on each horſe hired by the mile or ſtage, and 1s. 6d. on each if hired by the day. A number of additional regulations were at the ſame time enacted for ſecuring theſe duties. An addition of one halfpenny *per* mile, or three-pence *per* day, for each horſe riding poſt, was impoſed in 1785, by Stat. 25 Geo. III. c. 51. The duty is ſecured, by obliging every letter of horſes to deliver to the perſon hiring them a ticket, expreſſing the number of horſes hired, and either the diſtance in miles to be travelled, or that the horſes are hired by the day, as the caſe happens to be. Theſe tickets muſt be delivered to the bar-keeper at the firſt turnpike through which the traveller paſſes; and the turnpike-keeper gives, if demanded, what is termed an *exchange* ticket, to be produced at the next turnpike. The ſtamp-office iſſues to the perſon licenſed to let poſt horſes ſuch a number of theſe tickets as is required, and theſe muſt be regularly accounted for by the perſon to whom they are iſſued. As an effectual check upon his account, the turnpike-keeper is obliged to return back to the ſtamp-office all the tickets he takes up from travellers. Evaſions are by theſe means rendered difficult to be practiſed without running a great riſk of detection. In 1787, for the more effectually levying the poſt-horſe duties, a law was paſſed, authoriſing the commiſſioners of the ſtamp-office to let them to farm by public auction, for a ſum not leſs than the produce in the year ending 1ſt Auguſt 1786.

In the advertiſement publiſhed by the commiſſioners in conſequence of this law, previous to the receiving propoſals for farming them, the total amount of the duty for Great Britain is ſtated to have been at the period above referred to, L 119,873. The ſum for which that duty was farmed in 1794 amounted in all to L 140,030, of which the diſtrict of North Britain was L. 6000.

Soon after the tax was impoſed, conſiderable difficulties were raiſed about the meaning of the term *poſting*, and what mode of journeying ſhould ſubject travellers to duty. The old law, Stat. 9 Anne, c. 10. explained poſting to be "travelling ſeveral ſtages, and changing horſes;" but the acts impoſing the poſting duties expreſsly declare, that "every horſe hired by the mile or ſtage ſhall be deemed to be hired to travel poſt, although the perſon hiring the ſame doth not go ſeveral ſtages upon a poſt road, or change horſes;" and that "every horſe hired for a day or leſs period of time, is chargeable with the duty of three halfpence *per* mile, if the diſtance be then aſcertained; and if the diſtance be not then aſcertained, with 1s. 6d. each horſe." Horſes hired for any leſs time than two days are by theſe acts to be deemed to be hired for a day. An action was brought in 1788, in the court of exchequer at Edinburgh, to determine whether ſeveral diſputed caſes fell under the meaning of the act, and were liable to duty; when the following deciſions were given:

Saddle-horſes both hired and paid by the mile, and ſaddle horſes hired originally for an excurſion, but afterwards paid by the mile, were found liable to duty according to the number of miles paid for; carriage-horſes, where the carriage is hired and paid for only at the uſual rate of *outgoing* carriages, and no more, whether the perſon hiring it does or does not return in it, were found liable to duty only for the number of miles *out*; but if the carriage be hired and paid for, or actually paid for though not originally hired, at the uſual rate of carriages employed both to carry out and bring back the ſame company, the duty was found to be exigible according to the number of miles both out and home taken together. Hackney-coaches in Edinburgh, hired and paid for leſs than two miles, were found liable to duty for one mile.

No duty was found to be exigible on ſaddle-horſes hired for a mere excurſion, and paid for accordingly, where the diſtance neither is nor can be aſcertained, on hackney-coaches employed in the ſtreets for leſs than a mile, or for an excurſion or round of viſits merely; and on horſes or carriages hired for a journey of three days or more, and paid for accordingly, or paid for at the rate of three days, though the journey ſhould actually be performed in two full travelling days. The general rule of theſe deciſions was, that in every caſe, except unaſcertainable diſtance, or journeys exceeding two days, the mode of travelling fell under the legal definition of poſting. The only point that may ſeem doubtful in the judgments here ſtated, is that where the duty is found chargeable by the number of miles both going and returning. Yet as the law expreſsly declares, that horſes hired by the mile or ſtage are to be deemed *poſting*, and as the number of miles for which they are hired can only be aſcertained by the number paid for, it is clear, that where an addition to the outgoing charge is made on account of bringing back the perſon hiring the carriage, the carriage in that caſe is actually hired and paid for according to the number of miles both out and home, and the duty muſt fall to be rated accordingly. The doubtful points being now ſettled by the above deciſions, the mode of levying the duty in Scotland has been regulated agreeably to them ever ſince the matter was thus determined.

POSTERIOR, a term of relation, implying ſomething behind, or that comes after, another. In which ſenſe it is uſed in oppoſition to *prior* and *anterior*.

The back and hips are the poſterior parts of man. Ariſtotle has given prior and poſterior analytics. A date is poſterior to another, when it is later or freſher.

POSTERN, in fortification, a ſmall gate, uſually made in the angle of the flank of a baſtion, or in that of the curtain, or near the orillon, deſcending into the ditch; whereby the garriſon can march in and out, unperceived by the enemy, either to relieve the works, or to make private ſallies, &c.

The word is alſo uſed in the general for any private or back-door.

POSTHUMOUS a child born after the death of his father, or taken out of the body of a dead mother; from whence it is frequently applied to the works of an author not publiſhed till after his deceaſe.

POSTIL, a name anciently given to a note in the margin of the Bible, and afterwards to one in any other book poſterior to the text.

POSTING, among merchants, the putting an account forward from one book to another, particularly from the journal or waſte-book to the ledger. See POST and BOOK-KEEPING.

POSTLIMINIUM, among the Romans, the return of one who had gone to ſojourn elſewhere, or had been baniſhed, or taken by an enemy, to his own country or ſtate.

POSTPONING, putting any thing after or behind another with regard to time.

POSTSCRIPT, an article added to a letter or memoir, containing ſomething learnt or recollected after the piece was written.

POSTULATE, in mathematics, &c. is deſcribed to be ſuch an eaſy and ſelf-evident ſuppoſition, as needs no explication or illuſtration to render it intelligible; as that a right line may be drawn from one point to another.

POSTURE, in painting and ſculpture, the ſituation of a figure with regard to the eye, and of the ſeveral principal members thereof with regard to one another, whereby its action is expreſſed. A conſiderable part of the art of a painter conſiſts in adjuſting the poſtures, in giving the moſt agreeable ones to his figures, in accommodating them to the characters of the reſpective figures, and the part each has in the action, and in conducting and in purſuing them throughout.

Poſtures are either natural or artificial.

Natural poſtures are ſuch as nature ſeems to have had a view to in the mechaniſm of the body, or rather ſuch as the ordinary actions and occaſions of life lead us to exhibit while young, and while the joints, muſcles, ligaments, &c. are flexible.

Artificial poſtures, are thoſe which ſome extraordinary views or ſtudies occaſion us to learn; as thoſe of dancing, fencing, &c. Such alſo are thoſe of our balance, and poſture maſters.

A painter would be ſtrangely puzzled with the figure of Clark (a late famous poſture-maſter in London) in a hiſtory-piece. This man, we are told in the Phil. Tranſ. had ſuch an abſolute command of his muſcles, &c. that he could disjoint almoſt his whole body; ſo that he impoſed on the great ſurgeon Mullens, who looked upon him as in ſuch a miſerable condition, he would not undertake his cure. Though a well-made man, he would appear with all the deformities imaginable; hunch-backed, pot-bellied, ſharp-breaſted, &c. He disjointed his arms, ſhoulders, legs, and thighs; and rendered himſelf ſuch an object of pity, that he has frequently extorted money, in quality of a cripple, from the ſame company in which he had the minute before been in quality of a comrade. He would make his hips ſtand a conſiderable way out from his loins, and ſo high as to invade the place of his back. Yet his face was the moſt changeable part about him, and ſhowed more poſtures than all the reſt.

POTAMOGETON, POND-WEED: A genus of the tetragynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 15th order, *Inundatæ*. There is no calyx; but four petals; no ſtyle, and four ſeeds. There are 12 ſpecies, all of them floating vegetables on the ſurfaces of ſtagnant waters, affording an agreeable ſhade to fiſh, and food to cattle.

POTAMON or POTAMO, was a philoſopher of Alexandria. He kept a middle courſe between the ſcepticiſm of the Pyrrhonians and the preſumption of the dogmatiſts; but attached himſelf to none of the ſchools of philoſophy of his time. He was the firſt projector of the Eclectic ſect; for though that mode of philoſophiſing had been pretty common before, he was the firſt that attempted to inſtitute a new ſect on this principle. "Diogenes Laertius relates, that not long before he wrote his Lives of the Philoſophers, an Eclectic ſect, ἐκλεκτική τις αἵρεσις, had been introduced by Potamo of Alexandria, who ſelected tenets from every former ſect. He then proceeds to quote a few particulars of his ſyſtem from his Eclectic inſtitutes, reſpecting the principles of reaſoning, and certain general topics of philoſophical inquiry; from which nothing further can be learned, than that Potamo endeavoured to reconcile the precepts of Plato with thoſe of other maſters. As nothing remains concerning this philoſopher beſides the brief account juſt referred to in Laertius, an obſcure paſſage in Suidas, and another ſtill more obſcure in Porphyry; it is probable that his attempt to inſtitute a ſchool upon the Eclectic plan proved unſucceſsful. The time when Potamo flouriſhed is uncertain. Suidas places him under Auguſtus; but it is more probable, from the account of Laertius, that he began his undertaking about the cloſe of the ſecond century."

Enfield's Hiſtory of Philoſophy.

POTASH, the lixivious aſhes of certain vegetables, uſed in making of glaſs, ſoap, &c. See GLASS, SOAP, &c.

1
Dr Shaw's method of making potaſh.

The method of making potaſh is directed by Dr Shaw as follows. Burn a quantity of billet-wood to grey aſhes; and taking ſeveral pounds of theſe aſhes, boil them in water, ſo as to make a very ſtrong lixivium, or ley. Let this ley be ſtrained through a coarſe linen cloth, to keep out any black parts of the half-burnt wood that might happen to remain in the aſhes; then evaporate this ſtrained lye in an iron-pan over a quick fire almoſt to dryneſs: then taking out the matter remaining at the bottom, and putting it into an iron crucible, ſet it in a ſtrong fire till the matter is melted, and then immediately pour it out upon an iron plate, where it ſoon cools, and appears in the form of a ſolid lump of pot-aſh *. Much after this manner is pot-aſh made in the large way of buſineſs, for the ſervice of the ſoap-boiler, glaſs-maker, fuller, &c. but according to the difference of the wood, or combuſtible matter employed, with the manner of turning it, and conducting the proceſs, different kinds of potaſh are prepared. There are certain ſaline plants that yield this potaſh to great advantage, as particularly the plant kali; there are others that afford it in leſs plenty, and of an inferior quality, as bean-ſtalks, &c. but in general, all vegetable ſubjects afford it of one kind or other, and may moſt of them be made to yield it tolerably perfect after the manner of the proceſs already laid down, even the loppings, roots, and refuſe parts of ordinary trees, vine clippings, &c. The fixed ſalts of all vegetables excepting the kali and marine plants, when reduced to abſolute purity, or entirely ſeparated from the other principles, appear to be one and the ſame thing: whence it ſhould ſeem, ſays Dr Shaw, that by a ſuitable management, good ſaleable potaſh might be made in all places where vegetable matters abound. For if by examining Ruſſia (A) potaſh, for example, we find that its ſuperior excellence depends upon its being clear of earth, or upon its containing a large proportion of oil, or refined ſalt, theſe advantages may, by properly regulating the operation, be given to Engliſh potaſhes, ſo as perhaps to render the latter as good as the former: but where the potaſh of any remarkable ſaline vegetable is to be imitated, that of the kali, for example, the Doctor recommends a prudent ſprinkling of the ſubject with ſalt, or ſea-water, in the burning; and by theſe ways, properly diverſified, any principle that is naturally wanting might be artificially introduced ſo as to perfect the art of potaſh.

* See Pearl-Aſh, and Tranſactions of the Royal Iriſh Academy, 1789. art. 1. Claſs Science.

2
Account of Mr Stephens's manufacture.

About 40 years ago, or upwards, Mr Stephens, encouraged by the Society of Arts, &c. and by a parliamentary grant of 3000 l. eſtabliſhed a manufacture of potaſh in North America, which produced ſuch as was ſo perfectly good as to anſwer in bleaching and other uſes the purpoſes of *pearl-aſh;* and which at the ſame time afforded a very large produce. But the very great heat which his proceſs required, occaſioned the deſtruction of a very extenſive apparatus; and other circumſtances concurred to diſappoint the hopes and check the ſpirit of the proprietors. The manufacture was, however, afterwards undertaken and proſecuted by others. Mr Stephens's apparatus was as follows: Fig. 1. A is the bed of the kiln, which flies off about four feet by two from the grate, more or leſs according to the ſize; C is the aſh-hole, 2½ or 3 feet deep. Fig. 2. B repreſents quadrangular bars of iron, with their oppoſite angles placed upwards and downwards, not above an inch aſunder. Fig. 3. A, B, and C, are three ſteepers five feet deep, and of any width from four to eight feet ſquare, of the beſt white pine or cyprus plank, with ſquare joints and ſtrong oak framer, placed each over a receiver, with a cock to let off the lye, and a vent juſt beneath the ſurface of the grating. E repreſents three receivers, ſtanding each under, and projecting out, from its ſteeper. They muſt be made of the beſt ſtuff, carefully put together, and laid in tough clay well rammed within the ground, their tops being level with the ſurface: they need not be ſo large as the ſteepers by ſix, eight, or twelve inches. Fig. 4. E repreſents a falſe bottom or lattice of boards, eight inches deep and five ſquare, with a hole in the under edge of every partition for the lye to paſs into the ſteeper. Fig. 5. A is the veſſel over the furnace in which the lye and aſhes are mixed; B is a hole or funnel a few inches from the back of the furnace, with an iron ſocket to let the pipe through the hinder part of the arch, to reach down within two inches of the floor of the furnace. C is a caſt iron cauldron for boiling the lye to dryneſs when pearl-aſh is made. D is a veſſel whence the liquor is let into the cauldron as it evaporates. The mortar for building the furnace ſhould be made of loam; the arch ſhould be 18 inches thick, and the floor ſhould be laid with tiles on a layer of ſand an inch thick, with neat joints.

Plate CCCCXV.

3
Of his apparatus.

4
Proceſs without uſing a kiln.

Mr Stephens's proceſs, both with and without the kiln, was as follows. Cut timber, felled at any ſeaſon, into lengths of about eight feet; lay from three to ten of them lengthwiſe in a heap upon dry ground, and fill the vacancies between with ſmaller wood: the ſooner it is burnt after felling, the better. Set fire to it by laying embers on the bottom logs at each end; and for burning the bruſh and lappings, with other ſmaller woods, lay them lengthwiſe on the ground, top to top, lapping over a little, with the butt ends outwards, and as cloſe as a faggot; laying the large woods on top till the heap is full four feet high; the length of the bruſh ſet againſt each other making the breadth of the heap. As to the choice of the timber, old hollow trees, if not dead, are beſt: pine, cyprus, and cedar, are to be totally rejected.

As ſoon as the pile is burnt down, rake ſuch aſhes as lie round the outſide a little in towards the middle; add no freſh fuel, nor throw on any brands. Let the aſhes lie without ſtirring till you can juſt bear your hand in them; then carry them to a houſe, or under a ſhed, on a plank floor raiſed a little from the earth and well jointed;

(A) According to Sir Peter Warren, the beſt woods for making Ruſſia potaſh are, oak, aſh, poplar, hiccory, elm, hazle, and beech. They muſt be cut in November, December, January, and February, ſplit and ſtacked to dry. After 12 months in warm open weather, it muſt be burnt on a brick hearth by a ſlow fire in a kiln, or cloſe place; the aſhes muſt be ſifted through two ſieves, one finer than the other, and then put up in brick troughs or wooden backs, covered with rain or river water, and muſt remain well marſhed and incorporated five months. Brick furnaces ſhaped like bakers ovens muſt be heated with a ſtrong fire of oak or aſh, burning night and day; the prepared aſhes muſt be gradually thrown on the fire, when they will run into metal like lead: the fire muſt not go out till the furnace is nigh filled with potaſhes. The aſhes muſt then be broken to be taken out, but the larger the pieces the better; they muſt be preſerved from the air in tight caſks, the large pieces by themſelves, and the duſt by itſelf.

jointed; there wet them till brought nearly to the conſiſtence of mortar in the firſt mixture of lime and ſand, and ram them in a heap, in which they muſt lie full 20 days, or ſome months if you pleaſe; obſerving to be more ſparing of water in winter, and ramming them cloſer, and ſometimes wetting the top that it may never grow quite dry.

5 And with it. Plate CCCCXV.

Wood may alſo be burnt in a kiln, as fig. 1 and 2; and then it muſt be cut into ſuch lengths as may be moſt convenient for carriage, and beſt ſuit the ſize of the kiln. The mouth of the aſh-hole muſt be cloſe ſtopped by daubing the joints of the lid with loam, or throwing a bank of ſand or earth againſt it: keep the bed of the kiln filled with wood up to the ſurface, but not above it, and let it burn inceſſantly till the aſhes riſe within ſix or eight inches of the grate. Draw them out whilſt red-hot, and in that ſtate ſprinkle them with lye, from four to ſix caracts weight; weigh a ſmall vial which holds about four ounces very exactly; then fill it with water and weigh that alſo: divide the weight of water into equal parts till you come to $\frac{1}{128}$ of the whole, which is called a *caract*, $\frac{1}{64}$ two caracts, &c. until you have a weight equal to $\frac{1}{4}$ of the whole water, which is called 32 caracts: all which ſmall weights, together with one equal to the phial filled with water, are to be kept for weighing the lye in the ſaid phial till they are made damp; then ram them as before in a heap, but ſeparate from the aſhes made as above. N. B. By kiln-burning a ſtronger lye may be more certainly procured than by the other way, where rain may chance to fall on the aſhes before they can be removed.

The aſhes thus prepared are to be put in vats or ſteepers fig. 3, with a falſe latticed bottom as fig. 4; firſt putting coarſe wheat or rye ſtraw about a foot thick on the lattice or grating; on which put aſhes to within four or five inches of the top, ramming them all the way up, eſpecially at the ſides, with a ſmall light rammer, as tight as you can, without burſting the vat. Form on the top of the ſteeper a hollow baſon in the aſhes four or five inches deep, leaving the aſhes four or five inches thick on the ſides, by raiſing a ſmall bank round the ſides, ſo that the liquor may not overflow the edges of the aſhes at top: keep this baſon conſtantly filled with ſoft water in the ſteeper A, until the aſhes will imbibe no more, which will be in 24 hours or more, according as it is rammed; then turn the cock, and let off what ſhall be ſoaked through into the receiver or lower chamber of the ſteeper, and no more; for if the ſeveral runnings are not kept ſeparate, the lye will not be brought to its due ſtrength. Follow that ſteeper with freſh water on the ſame aſhes for ſeveral other runnings, which will each come off in a few days, till the liquor has neither ſmell nor taſte; then heave out the aſhes, and charge the ſteeper afreſh.

Upon drawing off the firſt running from the ſteeper A, fig. 3. fill the ſteeper B with aſhes as before, and put into its hollow at the top the lye ſo firſt run off, and the ſmaller or half lyes alſo, till full, and draw off as directed for the ſteeper A: if this weighs 18 caracts or more, pump it into the cyſtern F as fit for uſe; if it be ſhort of that, paſs it off as half lye to the ſteeper C, and through freſh aſhes till ſtrong enough. With kiln-aſhes only, from water paſſing through the firſt ſteeper, it will be ſtrong enough for the ciſtern, if the aſhes are well prepared. If your water be hard, let it ſtand two or three days expoſed to the air and ſun in a ſhallow back, and it will be ſoft. When you uſe kiln-aſhes with others, lay them at bottom.

The lye muſt be conveyed from the ciſtern F, as it is wanted to the veſſel A fig. 5; where with every gallon of proof lye mix three ounces of fine, light, wood aſhes; and to the lye that is $\frac{1}{4}$ over-proof put ſix ounces of aſhes; and if $\frac{2}{5}$ over-proof 12 ounces, increaſing or leſſening according to the ſtrength of the lye.

For evaporating the lye and melting the ſalt, heat a furnace till you bring it very near a white heat, of which the ſide-doors being red-hot is a mark. This will take 48 hours or more, if the furnace be quite cold; when thoroughly hot, a little fuel keeps it ſo. Then, through the cock of the veſſel A, paſs the mixture by the funnel B into the furnace, not ſo as to reach much beyond the middle of the floor, before it changes from dark to bright red, letting the heat prevail towards front or back as you ſee neceſſary. When the maſs begins to gather about the flues or in heaps, run in no more till the furnace is cleared by driving the fire backward. You muſt have two funnels, one ſoon choaking: in an hour or leſs will iſſue out a red hot ſtream of melted ſalt, which is potaſh, to be broken to pieces as ſoon as cold, and packed in tight cloſe caſks, being in no reſpect inferior to the beſt foreign aſh whatever.

6 Spaniſh potaſh the beſt.

The beſt potaſh is made from barilla, and comes from Spain. The plants from which it is procured are found in great plenty about Carthagena, where they are indigenous, and may be collected in a ſwamp called *Almojar* eaſt of that place; the *Sayones* barilla is the beſt. They are found, beſides all along that coaſt, on the borders of the Mediterranean for 60 leagues in length and 8 in breadth. About 150,000 quintals of it are annually exported from Spain. It produces a revenue of 25,500l. a year; each quintal paying a duty of 17 reals: yet Don Bernardo de Ulloa, A. D. 1740, ſays it was farmed at L. 1822, 4s. 3 d. M. Macdonnell has brought the manufacture of potaſh to its preſent perfection in Spain; but its exportation is materially injured hy the heavy tax on it. See Townſhend's *Travels*, vol. iii. p. 131. See alſo BARILLA, KELP, and FUCUS.

7 Dr Percival's account of making potaſh.

In the 70th volume of the Philoſophical Tranſactions we have an account of a method of procuring this ſalt from the putrid water which runs from dunghills. The proceſs is very eaſy, conſiſting only in ſimple evaporation of the fluid, and calcining the impure ſalt till moſt of the foulneſs is burnt out. From 24 wine-pipes full of this muck-water were obtained 9 cwt. 1 q. 12 lb. of ſaleable potaſh, valued at 42 s. *per* cwt; the expence of manufacturing them being only valued at 4 l. 9 s.

The potaſh thus made is of a greyiſh white appearance; deliqueſces a little in moiſt air; but if kept in a dry room, near the fire, acquires a powdery ſurface. It is hard and of a ſpongy texture when broken, with many ſmall cryſtals in its ſubſtance. The colour of its internal parts is duſky and variegated. To the taſte it is acrid, ſaline, and ſulphureous. It emits no ſmell of volatile alkali, either in a ſolid form, diſſolved, or when added to lime-water; neither does it communicate the ſapphire-colour to a ſolution of blue vitriol. Silver is quickly tinged black by it; a proof that it contains much phlogiſton. Ten grains of this potaſh required 11 drops of the weak ſpirit of vitriol to ſeparate it.

The like quantity of ſalt of tartar required 24 drops: a ſtrong efferveſcence occurred in both mixtures; and a ſulphureous vapour exhaled from the former. A tea ſpoonful of the ſyrup of violets diluted with an ounce of water was changed into a bright green colour by five grains of the ſalt of tartar; but ten grains of this potaſh were neceſſary to produce the ſame hue in a ſimilar mixture. Half an ounce of the ſalt diſſolved entirely in half a pint of hot water; but when the liquor was cold, a large purple ſediment ſubſided to the bottom; and it was found that this ſediment amounted to about two-thirds of the whole quantity of aſhes uſed.

Dr Percival, the author of this paper, concludes with obſerving, that this potaſh is a true fixed vegetable alkali, produced by putrefaction; that the quantity of alkali contained in it may be eſtimated at one-third of its weight, whereas the white Muſcovy aſhes are ſaid to yield only one-eighth part; that no quicklime appears to be contained in this potaſh, for a ſolution of it poured from its ſediment remained clear though long expoſed to the air: that it would be worth trying, whether the large purple ſediment, which ſubſides when this potaſh is lixiviated, might not be applied to the manufacture of Pruſſian blue, or uſed in the manner recommended by Macquer for dyeing wool and ſilks; and that this manufacture will furniſh the farmer for top-dreſſing for his garden and land, of great fertilizing powers. See *Phil. Tranſ.* Vol. LXX. p. 345.

8
Other attempts.

Theſe are the proceſſes moſt eſſentially different from one another which have appeared concerning the manufacture of this uſeful ſalt. Some indeed have attempted to compoſe it on the ſuppoſition that alkali conſiſted of an earth combined in a peculiar manner with a certain acid. But the little ſucceſs of all theſe attempts ſhow that they have been built on a falſe principle. The only method of producing alkaline ſalts originally is from the aſhes of vegetables; and the vegetable ſubſtances which yield the largeſt quantity of them are tartar and marine plants. From the former the pureſt and ſtrongeſt vegetable alkali is obtained, and from the latter the mineral alkali. From other vegetables, as fern, broom, bean-ſtalks, &c. an alkaline ſalt is produced, but ſo impure, and in ſuch ſmall quantity, that no manufacture of it can be eſtabliſhed with any reaſonable expectations of profit.

9
On extracting its alkaline part from rock-ſalt.

Dr Watſon (the preſent biſhop of Landaff) ſuggeſts, that the inveſtigation of a method of extracting its alkaline part from rock-ſalt would be a moſt ſerviceable diſcovery. We have inexhauſtible mines of rock ſalt in this country, which (he obſerves) the proprietors can afford at ten ſhillings a ton. A ton of rock ſalt contains about half a ton of mineral alkali, which is for moſt purpoſes far preferable to potaſh. To thoſe who have leiſure to attempt ſuch a diſcovery he gives the following hint: whether the alkaline part of rock-ſalt may not be obtained by calcining it in conjunction with charcoal in open fires? His reaſon for this conjecture is founded upon the following experiment: upon burning ſea-wreck to a black coal and ſtopping the proceſs at that point, he has obtained great plenty of common ſalt, but no mineral alkali from the black aſhes: though we are certain, that when the black aſhes are thoroughly calcined, or reduced to white aſhes, mineral alkali may be obtained from them. This makes it probable, that the common ſalt contained in the black aſhes of ſea-wreck is decompoſed, and changed into a mineral alkali, during the burning of the black aſhes. There are reaſons to ſuppoſe, that the cinder of pit-coal would anſwer the purpoſe better than charcoal. *Chem. Eſſ.* vol. i. p. 136, &c.

10
Dr Home's experiments on the potaſhes of different countries.

The potaſhes of different countries vary much in quality; and the experiments of Dr Home, in his treatiſe on Bleaching, ſeem to ſet forth their different properties in the cleareſt point of view. The different kinds tried by him were,

Blue pearl-aſhes. Theſe appear to be a pure alkaline ſalt, mixed with a ſmall quantity of vitriolated tartar and earth. Half a pound of this, filtered and evaporated, yielded 5½ ounces of pure ſalt.—Here, however, we muſt obſerve, that though the quantity was ſo far diminiſhed by this operation, yet we are not to imagine that the whole of this diminution was owing to impurities; for all ſalts are deſtroyed in ſome meaſure by ſolution in water and exſiccation.

2. *White pearl-aſhes* are nearly of the ſame quality with the former; half a pound of them giving five ounces and ſeven drams of pure ſalt, with ſome vitriolated tartar and earth.

3. *Ruſſia* or *Muſcovy aſhes* have very much the appearance of ſlacked lime, and are, like it, friable betwixt the fingers. They adhere to the tongue; and their alkaline taſte ſoon goes away, leaving in the mouth a ſtrong taſte of lime. Some ſmall bits of charcoal are obſervable in their compoſition, and they never turn moiſt in the air. Half a pound of the ſalt lixiviated with water and evaporated, gave only 10 drams 15 grains of very cauſtic ſalt. Theſe conſiſt therefore of a ſmall quantity of alkaline ſalt united with a large quantity of lime.

4. *Caſhub-aſhes* are of the colour of iron ſtone, and extremely hard, with many ſhining particles of charcoal in them. They have a ſaline taſte, with a conſiderable degree of pungency; feel gritty in the mouth when broke in pieces by the teeth; and will diſſolve in water. To extract the pure ſalt, half a pound of the aſhes were boiled in a pint of water; then that water poured off, and half a pint put on the aſhes again; and ſo on, till the aſhes taſted no more ſalt. This boiling took 24 hours, and the laſt water that came off had a ſtrong taſte of ſulphur, and was blackiſh. A piece of ſilver put in the decoction was in a few minutes turned almoſt black; but though the decoction was evaporated conſiderably, it did not turn ſilver black more ſpeedily than before. The whole, when totally evaporated, yielded only 10 drams of a brown ſalt having a ſtrong cauſtic alkaline taſte. Some Caſhub-aſhes powdered, and often waſhed in water ſo that the ſalts were all carried off, were infuſed in water. After ſtanding ſome time, there was a weak lime-water, with ſomething of a ſaline taſte, but no pellicle. Some of this reſiduum was put into a reverberatory furnace for two hours; after which it afforded good lime-water. Caſhub-aſhes then appear to contain an earth half vitrified, ſome lime, alkaline ſalts, and a quantity of ſulphur.

5 *Marcoſt-aſhes*, are of a paler colour than the former, with ſome ſmall pieces of charcoal in their compoſition. They have a ſtrong ſaline taſte; and ſo great pungency, that they cannot be held long in the mouth. Half a pound diſſolved in water, filtered and evaporated, yielded 11 drams one ſcruple and two grains of al-

kaline reſiduum. The decoction blackened ſilver, but not ſo ſtrongly as the former; and by evaporation it quickly loſt that quality.

11 On manufacturing them in Britain.

Our author next proceeds to conſider the probability of manufacturing theſe aſhes in Britain. On which ſubject he has the following obſervations.—— "The blue and white pearl aſhes we have diſcovered to be pure alkaline ſalts, without any conſiderable mixture of heterogeneous, bodies. Their purity ſhows the lixive to have been ſtrained through ſome cloſe ſubſtance, ſuch as linen or flannel. The blue aſhes ſhow by their colour that they have ſuſtained the moſt fire. But both of them are ſo much alike, that the one may be ſubſtituted for the other; and therefore we ſhall conſider them in one view.

"Every one knows that alkaline ſalts, ſuch as theſe, are got from all plants except the alkaleſcent, and from all trees except the moſt reſinous, which afford them in very ſmall quantity. Theſe plants or trees, when found, are pulled or felled in the ſpring, dried, and burnt to aſhes. By the affuſion of warm water the ſalts are diſſolved, and, by ſtraining, ſeparated from the earth along with the water. This ſaline liquor, which is called a *lixive*, is evaporated over a fire; and what remains is an alkaline ſalt of the ſame kind with the pearl-aſhes.

"I was informed by a ſkilful bleacher in Ireland, that he practiſed a more expeditious way of extracting the ſalts. He bought the aſhes of different vegetables from the commonalty for 9 s. a buſhel. From theſe a very ſtrong lye was made, into which dry ſtraw was dipped until it ſucked up all the lye. This ſtraw was afterwards dried and burnt, and gave him ſalts which he ſhowed me, almoſt as good and pure as the pearl-aſhes. This method I have ſeveral times tried; but could never burn the ſtraw to white aſhes, the ſalts diminiſhing the inflammability of the ſtraw. It is a very expeditious method if it can be practiſed. But I can ſee no occaſion for bringing the lye into a ſolid form, as the ſalts muſt again be diſſolved in water before they can be uſed. The ſtrength of the lye can eaſily be determined by the hydroſtatical balance.

"Though I make no queſtion, that the quantity of ſalt, in plants of the ſame ſpecies, will vary in different ſoils and climates; yet it would be of advantage to have the proportion aſcertained in general. Some trials of this kind I have made.

"Two pounds of fern which had been pulled Auguſt 16. were dried, and burnt to white aſhes. Theſe weighed 7 dr. and taſted very ſalt. When lixiviated, ſtrained, and evaporated, they gave me 49 gr. of ſalt, about the eighth part of the aſhes. If the fern had been pulled in April, it would have afforded more ſalt. Why then ſhould we not prepare ſalts from this vegetable? There is more of it growing on our hills than would ſerve all our bleachfields. The Iriſh make great uſe of it.

"From 11 oz. of tobacco-aſhes I had 1 oz. of ſalt. Two ounces of peat-aſhes afforded half a drachm of ſalt. Nettles, I am informed, afford much ſalt. Furz and broom, natives of this country, are very fit for this purpoſe.

"But the kelp, as it grows in ſuch plenty along our ſhore, and contains more ſalt than any other vegetable I know, would be the moſt proper, were it not for a mixture of ſome ſubſtance that renders it unfit for bleaching, at leaſt of fine cloths, after they have obtained a tolerable degree of whiteneſs. It is obſerved by bleachers, that, in theſe circumſtances, it leaves a great yellowneſs in the linen. As theſe aſhes are much uſed in Ireland, and as it is not uncommon to bleach coarſe cloths with them in Scotland, a diſquiſition into their nature, and ſome attempts to purify them, may not be improper. There are no aſhes ſold ſo cheap as theſe; for the beſt gives but 2 l. the 2000 weight (B). They may, therefore, allow of more labour to be expended on them, and come cheaper at long-run than the foreign ſalts.

"I dried ſome ſea-ware, and burnt it, though I found that laſt operation very difficult. When I had kept it fuſed in the fire for two hours, it weighed 3½ oz. I poured on the aſhes an Engliſh pint and a half of cold water, that I might have as little of the ſulphur as poſſible. This lye, after it had ſtood for ſome hours, was poured off clear, and had but a ſlight tendency to a green colour. I made a ſecond infuſion with milk-warm water, and poured it off from the ſediment. This had a darker colour than the former; was kept ſeparated from it, and evaporated by itſelf. There was a third infuſion made; but having no ſalt taſte, it was thrown away. The ſecond infuſion ſeemed to contain more ſulphur than the firſt; and a piece of white linen kept in it half an hour, while it was boiling, was tinged yellow, and could not be waſhed white again. The earthy part remaining, weighed, when well dried, 1 oz. 2 dr. The ſaline decoction evaporated by degrees, and ſet at different times in a cellar to cryſtallize, afforded me 5 dr. 46 gr. The liquor, when entirely evaporated, left 4½ dr. of a yellow ſalt, which appeared to be a ſtrong alkaline. The ſalts which cryſtallized ſeemed to be moſtly ſea-ſalt, with a conſiderable quantity of ſulphur, and ſome alkaline ſalt. There appeared no ſigns of the bittern in theſe ſalts, as their ſolution did not turn turbid with the oil of tartar. Nor is any of the bittern to be expected in kelp aſhes, although it probably is to be found in the recent vegetable; becauſe the alkaline ſalts formed by the fire muſt have changed it into a neutral. The lye made warm with water, being evaporated, left 4 dr. of a black bitter ſalt, which, from its quantity of ſulphur, appeared unfit for bleaching. Theſe aſhes, then, ſeem to be a compoſition of ſomewhat leſs than the fourth of ſulphur, the ſame quantity of ſea-ſalt, about a fourth of alkaline ſalt, and ſomewhat more than a fourth of earth. The alkaline ſalt contained in kelp-aſhes amounts to one penny a pound. This cheapneſs makes it worth our pains to beſtow ſome labour on them.

"If the bad effects in bleaching with kelp-aſhes ariſe from

(B) "Since this treatiſe was written, however, the price of kelp has been advanced to 7 l. or upwards the 2000 weight; ſo that thoſe who would now attempt any thing of this kind, muſt alſo manufacture the kelp themſelves."

from the ſea-ſalt, as ſome of the moſt knowing bleachers think, they can be freed from it in an eaſy manner. Let a lixive of kelp-aſhes be made with cold water, for that does not extract ſo much of the ſulphur; it muſt ſtand but for a ſhort time, for theſe ſalts diſſolve eaſily; decant it, and evaporate the lye. As the boiling continues, the ſea-ſalt will cryſtallize. When that is all ſeparated, the remaining lye will contain alkaline ſalt with ſome ſulphur. This operation every maſter of a bleachfield may learn and overſee, without taking up much of his time. A ſimilar proceſs is carried on by common ſervants in the alum-works who have by practice learned it from others.

"I had ſome hopes that the ſulphur might be carried off by long roaſting, ſuch as theſe ſalts undergo before they are fuſed in order to be turned into glaſs; becauſe I had obſerved, that the longer time they were kept in the fire, the freer were they from this ſulphureous part.

"I ordered a quantity of kelp aſhes to be kept in the furnace of a glaſshouſe, where the heat was juſt below the vitrifying point, for 24 hours. During this time they had loſt almoſt four-fifths of their weight. They were now much freer from their ſulphur, and were of a light colour; but much of the alkaline ſalt had been driven off with the oils. If a lye is much impregnated with this ſulphureous matter, it appears to be carried off in a great meaſure by long boiling.

"We come now to explain the method of manufacturing the white Muſcovy aſhes. We have ſhown, by undoubted experiments, that the greateſt part of theſe aſhes conſiſts of lime; and yet we have ſeveral acts of parliament which forbid the uſe of that material under ſevere penalties. The parliament were in the right to diſcharge its uſe, upon the diſadvantageous reports which were made to them. We ſhall immediately ſee how dangerous a material it is when uſed improperly, or without the mixture of alkaline ſalts, which render it ſafe, and more ſoluble in water. But I will venture to ſay, that experiment will not ſupport the prejudice entertained with regard to it, if carried any further.

"Since bleaching, then, cannot be carried on without it (for thoſe aſhes which contain it are quite neceſſary in that operation), and ſince we import them from foreign countries, let theſe prejudices againſt it ceaſe, and let us only conſider how we may render our own lime as ſafe as the foreign. If we can do that, the wiſdom of the legiſlature will be as ready to abrogate theſe acts as they were to make them.

"By my experiments on the white Muſcovy aſhes, I got about the eighth part of alkaline ſalts from them. This made me expect, that, by mixing in the ſame proportion quicklime and alkaline ſalts, I ſhould be able to produce Muſcovy aſhes.

"To an ounce of quicklime and a drachm of white pearl aſhes, I added about a gill of water, and boiled them together till the water was all evaporated. The taſte of this ſubſtance was little different from lime. To recover the ſalts again from the lime, I diſſolved it in water ſtrained off the liquor, and evaporated it. Inſtead of the drachm of ſalts, I had but 2 gr. of a ſubſtance which was more earthy than ſaline.

"To 3dr. of quicklime and as much potaſhes, I added a pint of water, and kept it boiling for two hours till it was evaporated. I diſſolved it again in water, which being filtered and evaporated, gave me 1½ dr. of a cauſtic ſalt, that liquefied in the air when it had been but four minutes from the fire. It appears, then, that the alkaline ſalts are deſtroyed by lime, and that a great part of them can never be again recovered. From the remaining lime, after the ſalts were extracted, I got ſtrong lime-water, but without a pellicle. This ſhows, that a quantity of alkaline ſalts, equal to the lime, boiled with it for two hours, are not able to fix all the ſoluble part of the lime.

"From theſe experiments we may draw ſome corollaries with regard to the preſent ſubject. *1ſt*, That evaporating the water from the lime and ſalts by boiling, is a moſt unfrugal way of preparing theſe white aſhes. *2dly*, That theſe aſhes ought to be kept cloſe ſhut up in caſks; for if expoſed to the open air, though in a room, the alternate moiſture and drought muſt fix their moſt uſeful parts. This I have found to be fact: for the ſalts that I made became leſs pungent by keeping; and I have obſerved, that the ſurface of the Muſcovy aſhes loſt all pungency by being expoſed to the air, while their internal parts ſtill retained it. *3dly*, That all boiling is prejudicial to theſe Muſcovy aſhes, as it fixes, and that quickly, their moſt ſubtile and probably their moſt ſerviceable parts.

"Let us now proceed to another method of making theſe white aſhes. I imagined, that if the ſalts were diſſolved in water, and the quicklime ſlacked with that, the maſs would ſoon dry without the aſſiſtance of fire. In this way I added equal parts of both; but the compoſition was ſo ſtrong, that it bliſtered my tongue if it but touched it. When the fourth part was alkaline ſalt, it bliſtered my tongue when kept to it a few ſeconds. I could taſte the ſalts plainly in the compoſition, when they made but the thirty-ſecond part of the whole.

"I thought, when compoſed with the eighteenth part of ſalt, it had, when freſh made, juſt the taſte and look of the Muſcovy aſhes; nor could any perſon have diſtinguiſhed them. This I once imagined was the proportion; but when I found that the ſaline pungency ſoon turned weaker by keeping, and that this compoſition would not afford the ſame quantity of ſalts that the Muſcovy aſhes did, I ſaw that a much greater quantity of ſalts was neceſſary. The proportion appears to be one of ſalt to four of lime, prepared in this laſt way. Three drachms of aſhes prepared in this way, and kept for a fortnight, gave me but 15 grains of ſalt; which is but the half of what the Muſcovy would have afforded. I find, if the quicklime is firſt quenched, it does not fix the ſalts ſo much; and therefore is better and cheaper. One drachm of potaſhes diſſolved in a little water, and added to 3 drachms of quenched lime, gave me 44 grains of a very cauſtic ſalt. I prefer this method as the beſt.

"The manufacturers of this ſalt probably pour the lixive upon the lime, as they can know by its ſpecific gravity what quantity of ſalts is in the water, and ſo ſave themſelves the expence of procuring the ſalts in a dry form.

"The manufacture of the Marcoſt and Caſhub aſhes remains yet to be explained. We have diſcovered that both of them contain ſulphur, earth alkaline ſalts, and lime; and differ in nothing but in the Caſhub's having more ſulphur than the Marcoſt aſhes. We ſhall therefore conſider them together.

Whether theſe two ſpecies of aſhes are of any uſe in bleaching, may be, and has already been, diſputed. I find they contain no other principles, the ſulphureous part excepted, then the former aſhes combined together. Why then ſhould we expect any other effects from the ſame ingredients in the Marcoſt and Caſhub aſhes, than what we have from either of the pearl and Muſcovy aſhes mixed together? The ſulphureous principle in the former muſt have very bad effects; as I find by experiment, that it leaves a yellowneſs on cloth that is very hard to be waſhed out. It is owing to this ſulphureous principle that linen, after it has been waſhed with ſoap, and is pretty well advanced in whiteneſs, is apt to be diſcoloured by lye which is brought to boil: for, by boiling, the ſulphureous part is extracted from theſe aſhes, and the lye becomes of a deep brown colour. Daily practice, then, ſhows the diſadvantage of this ſulphureous principle. Beſides, as ſulphur unites itſelf quickly and firmly with alkaline ſalts, it muſt weaken or altogether deſtroy a great quantity of theſe in the Marcoſt and Caſhub aſhes, and ſo render them of no effect in bleaching. Theſe two reaſons ſeem to me ſufficient to exclude them from the bleachfield; eſpecially as, by increaſing the other materials, we can attain perhaps more ſpeedily the ſame end.

"However, as cuſtom has introduced them into general practice, we ſhall conſider how they are to be manufactured. Dr Mitchel, has, in a very ingenious and uſeful paper, contained in the Philoſophical Tranſactions for the year 1748, delivered an account tranſmitted to him by Dr Linnæus of the method of making potaſhes in Sweden. This account was contained in an academical diſſertation of one Lundmark upon this ſubject at Aboe in Sweden. The ſubſtance of this account is, 'That birch or alder is burnt by a ſlow fire to aſhes, and made into a paſte with water. This paſte is plaſtered over a row of green pine or fir logs. Above that is laid tranſverſely another row of the ſame; and that likewiſe is plaſtered over. In this way they continue building and plaſtering till the pile be of a conſiderble height. This pile is ſet on fire; and whenever the aſhes begin to run, it is overturned, and the melted aſhes are beat with flexible ſticks, ſo that the aſhes incruſt the logs of wood, and become as hard as ſtone.' This, in the Doctor's opinion, is the method of making the potaſhes that come from Sweden, Ruſſia, and Dantzic: and that there is no other difference betwixt the aſhes made in thoſe different countries, but that the Ruſſian, containing more ſalt, muſt be made into a paſte with a ſtrong lye.

"There would appear, by my experiments, a greater difference than this betwixt the Swediſh aſhes, if that is the true proceſs, and thoſe I have examined. I had diſcovered the greateſt part of the Muſcovy aſhes to be lime. I ſuſpected it might enter into the compoſition of the Marcoſt and Caſhub; and have accordingly diſcovered it there. Without the ſame grounds, none would ever have ſearched for it. Whence then comes this lime? It muſt either enter into its compoſition, or ariſe from the materials managed according as the proceſs directs.

"I have tried the birch aſhes made into paſte with water. I have tried common charcoal made into a paſte with a third part of potaſhes, and kept them in a ſtrong reverberatory heat for ſome hours, and yet no ſuch cauſtic ſubſtance appeared. I have kept earth and ſalts of kelp-aſhes fuſed together for 24 hours in the furnace of a glaſshouſe, where the heat was juſt below the degree of vitrification; and yet no remarkable cauſticity appeared afterwards in the concreted maſs. But ſuppoſing that there did, will ever this account for the generation of lime? Theſe chemiſts do not aſſert that it is a calcareous cauſticity. The earth of vegetables kept in fuſion with their ſalts, is ſo far from turning into a quicklime, that the maſs takes the oppoſite courſe, and becomes glaſs. Bodies that, by the laws of nature, are vitreſcible, can never, ſo far as we know, become calcareous. In one or other of theſe two ſubſtances all bodies terminate that are changeable by fire; and vegetables are of the former kind. Here it may be aſked, Why then, ſince they endure ſuch a fire, are they not vitrified? the objection would be juſt, did they contain nothing elſe but what was found in vegetables. But if we once allow that lime is one of the materials, the difficulty is eaſily ſolved: for lime, we know, in proportion as it is mixed, hinders the vitrification of all bodies. In effect, the earthy part in theſe aſhes is almoſt vitrified: and I think that I have carried the vitrification yet farther in that part; but I never was able, with the utmoſt heat of a reverberatory furnace, continued for ſix hours, to produce any thing like a thorough vitrification in theſe aſhes. The heat of the fire uſed in the proceſs would ſeem to be very great; and muſt, if it were not very difficult, reduce them to glaſs. The invitreſcible nature of theſe ſalts, ſo far from being an objection, becomes a ſtrong proof of my opinion.

"Theſe ſalts have a remarkable pungency. This we have already ſeen is the natural effect of quicklime on ſalts.

"Theſe ſalts are found to be the fitteſt for making ſoap, and to incorporate ſooneſt and beſt with oils. Salts, we know, of themſelves do not readily unite with oil; but when once mixed with quicklime, they have a greater tendency to union.

"Again, I find that theſe aſhes are more eaſily fluxed than charcoal made into a paſte with the third part ſalt; which is much more than the aſhes contain. Now, it is obſerved that quicklime increaſes the fluxing power of alkaline ſalts; for the common cauſtic made of quicklime and alkaline ſalts is ſooner fuſed than the latter alone.

"From theſe reaſons, and the experiments that diſcover lime in theſe aſhes, I am led to think, that it is not generated by the proceſs, but mixed with the aſhes when they are made into a paſte. The following experiment is a convincing proof of what I have been endeavouring to make out.

"I boiled ſome peaſe-ſtraw in a ſtrong lye of pearl-aſhes burnt into a black coal, and made it into a paſte with water. Another quantity of ſtraw was boiled in a lye made of one part of quicklime and four parts of pearl ſalts, the lye being poured off turbid from the lime. This ſtraw was likewiſe burnt when dry, and made into a paſte. Theſe two ſubſtances were put into ſeparate crucibles, and fluxed in a reverberatory furnace. The latter appeared to reſemble the Marcoſt and Caſhub aſhes more than the former, which ſeemed to want their pungency."

12 Potaſhes and pearl-aſhes obtained from neutral ſalts.

Though the only method of preparing the alkaline ſalt originally is by the combuſtion of vegetables, yet there are ſome neutral ſalts from which if it were poſſible to expel the acid, we ſhould have it in our power to procure the fineſt pearl-aſhes in vaſt quantity. Theſe are vitriolated tartar, nitre, but eſpecially ſea-ſalt, on account of the inexhauſtible quantities of it to be met with in the waters of the ocean. Unhappily, however, there are ſome objections to every one of thoſe. The vitriolated tartar, or any other ſalt in which the vitriolic acid enters, cannot be decompoſed without converting the acid into ſulphur by charcoal-duſt; in which caſe it is as difficult to get free of the ſulphur as of the acid; and if we attempt it by frequent ſolutions in water, we deſtroy the phlogiſton of the ſulphur, and have only vitriolated tartar again inſtead of alkali. See CHEMISTRY, nº 716, &c.

With reſpect to nitre, though its acid may be expelled by fire, yet it is too high-priced, and too much uſed in other manufactures, to be thought of for this purpoſe. A potaſh manufacture from ſea-ſalt has indeed been lately erected in England. The principle on which this was eſtabliſhed is, that the acid of ſea-ſalt may be extracted by means of lime; and accordingly we find that the ſaline effloreſcence, which frequently appears on walls, conſiſts chiefly of the marine alkali deprived of its acid. But this, though delivered on the credit of a very eminent chemiſt, we can affirm from our own obſervation to be a miſtake. Of the many caſes in which we have examined this efflorescence only one was found to be alkaline; the others uniformly appeared to be true Glauber's ſalt compoſed of the vitriolic acid and foſſil alkali. Neither did this appear to be formed by any decompoſition of ſalt originally in the plaſter, but to be a real generation of both acid and alkali where none of them exiſted before. See EFFLORESCENCE.

POTATO, in botany. See SOLANUM.

1 How potatoes were introduced into Britain.

Potatoes, it is generally thought, came originally from North America, where they were not reckoned good for food. They were firſt (we are told) introduced into Ireland in the year 1565, and from thence into England by a veſſel wrecked on the weſtern coaſt, called *North Meols*, in Lancaſhire, a place and ſoil even now famous for producing this vegetable in great perfection. It was 40 years after their introduction, however, before they were much cultivated about London; and then they were conſidered as rarities, without any conception of the utility that might ariſe from bringing them into common uſe. At this time they were diſtinguiſhed from the Spaniſh by the name of *Virginia potatoes*, or *battatas*, which is the Indian name of the Spaniſh * ſort. At a meeting of the Royal Society, March 18th, 1662 3, a letter was read from Mr Buckland, a Somerſet gentleman, recommending the planting of potatoes in all parts of the kingdom to prevent famine. This was referred to a committee; and, in conſequence of their report, Mr Buckland had the thanks of the ſociety, ſuch members as had lands were intreated to plant them, and Mr Evelyn was deſired to mention the propoſals at the cloſe of his Sylva.

2 Their late introduction into Sweden.

In Sweden, notwithſtanding the indefatigable induſtry of Linnæus, the culture of potatoes was only introduced in 1764, when a royal edict was publiſhed to encourage their general cultivation. They were known there, however, at an earlier period; for in *the Memoirs of the Royal Academy of Sciences in Sweden*, 1747, M. Charles Skytſe propoſed to diſtil brandy from them, in order to ſave corn, which in that country is very dear. He found by experience, that an acre of land ſet with potatoes will yield a much greater quantity of brandy than when ſown with barley.

3 Their great utility.

The utility of potatoes to the common people is well known, and this utility has brought them into general uſe, and has extended them over every part of this country. To promote this utility, and to make their cultivation more eaſy, a variety of experiments and inquiries have been made. Some of theſe we ſhall now lay before our readers, without repeating, however, what has been ſaid on the ſame ſubject in the article [illegible]GRICULTURE, nº 158—167.

4 Remarks and experiments on their culture.

By many people the Iriſh purple potato is thought to be the ſweeteſt and beſt; and of theſe the bright and middle-ſized are directed to be ſet whole, in February, March, and April, in a fine deep tilth, in any ſoil. During the froſt, the firſt ſetting ſhould be covered with litter or fern. They ſhould be ſet ſix inches deep, and a yard diſtant from each other every way, in a kind of hillocks like a mole-caſt; and they muſt be moulded every month or fortnight, as high as poſſible. By July or Auguſt, under each hillock there will be nearly a buſhel of potatoes. The white kidney potato runs all into ſtringy roots in looſe ground, while the pink-coloured will do extremely well in the way we have now directed; and the ſmalleſt of them, though often given to hogs, unleſs they be otherwiſe improper or unhealthy, will be very good feed.

The following experiments concerning the culture of potatoes are related in the Georgical Eſſays.

5 Of the Howard potato.

"By all the experiments that have been made, the Howard or large Bedfordſhire potato is found to produce the largeſt crop. On that account they are chiefly uſed in feeding of cattle. In two beds, four feet wide, and 200 feet long, I planted in a common field a ſufficient number of ſets of this kind of potato, and managed them by a horſe-hoe. The produce was 64 buſhels, each buſhel up-heaped, weighing about 70 lb. My cattle eat them boiled with as much eagerneſs as the beſt ſorts, and came on as well with them. I have built a boiling-houſe, &c. on Mr Young's plan, and during this whole winter have boiled potatoes for my cattle. For the fattening ones, I mix ground oats with them; and for the milk-cows, malt-duſt; and dare venture to affirm, that they are much more profitable than either turnips or cabbages. Once, when my potatoes grew low. I deſiſted giving them to the milking-cows. Immediately, though fed with the beſt hay, they fell off amazingly in their milk. I therefore began again; and in a week's time they gave better than one-third more butter. I own this accidental diſcovery gave me much ſatisfaction, as it confirmed my opinion, that potatoes boiled are an excellent winter food for cattle. Their culture is not ſo difficult, at leaſt not ſo precarious, as either turnips or cabbages. Their value is ſuperior, and there is no riſk of their giving a diſagreeable taſte either to butter or milk. Add to this the vaſt increaſe of the Howard potato, and its equality with the beſt ſorts when uſed for cattle.

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* See Convolvulus, nº 5.

6 Of the increaſe of potatoes.

"My gardner cut a large potato into nine pieces, which he planted with dung, in a drill, in the garden. By earthing up and laying the ſhoots, he produced 575 (A) ſizeable potatoes, which weighed eight ſtone eight pound. Another of my ſervants produced, in the field, ſeven ſtone of good potatoes from the ſame number of ſets. Though this experiment cannot always be executed in its full force in an extenſive ſcale, it ought, notwithſtanding, to be imitated as nearly as circumſtances will allow. It ſhows, in the moſt diſtinguiſhing manner, the uſe of clean and careful huſbandry.

"On the 14th of April, I cut a large white potato into 17 ſets, which were planted in as many hillocks, at the diſtance of four feet. In the courſe of growing, the plants were earthed up, and on the 14th of October the crop was taken up: The produce, 10 pecks of ſizeable potatoes. At the time that this experiment was made, I had ſeveral hillocks, in which I put three and four ſets of the ſame kind of potato. But, upon the moſt careful examination, I could not obſerve that theſe hillocks produced a greater crop than the others planted with a ſingle ſet. Hence it is obvious, that the potato ſpreads its root moſt kindly when leaſt crowded."

While ſpeaking of the increaſe of potatoes, we cannot help taking notice of a memoir by John Howard, Eſq; of Cardington, in Bedfordſhire, on a new kind of potato remarkable for its prolificacy. "In the year 1765 (ſays he) being at Cliſton, near Briſtol, I was informed a perſon had brought from America a new ſort of potato, and with ſome trouble I procured half a dozen roots of it, as the greateſt part of thoſe brought over were already planted. That autumn I planted three of them, and in the following ſpring the other three, in my garden at Cardington in Bedfordſhire; ſetting them in hillocks about ſix feet aſunder. The ſtrength of the ſtems, and largeneſs of the bloſſom and apples, gave the pleaſing proſpect of great increaſe: and accordingly, when I took them up in the autumn 1766, I found they had increaſed far beyond any of the common ſort, which for ſome years I had encouraged our cottagers to cultivate. The produce from each cutting was in weight from 26 to 27 pounds and a half. I ſent for two of the Bedford gardeners, who ſerve the market, to ſee them taken up, and they were ſurpriſed at the great increaſe. I gave ſome of them to theſe gardeners, and others to almoſt all our own cottagers. The increaſe continued to appear the ſame in the ſucceeding year, viz. 1767, as in the laſt: only, as many of the ſingle potatoes had been then found to weigh four or five pounds each, I had now planted moſt of them in drills three feet aſunder, in order to procure a greater number, and a leſs ſize. Their produce was now from 22 to 30 pounds from each cutting; and the potatoes were more ſizeable for common uſe. The vegetation was not ſo luxuriant as in thoſe I before planted in hillocks; but the increaſe of theſe was, allowing the cuttings to weigh one ounce, full 400-fold. Having laſt year upwards of a waggon-load of theſe potatoes, I with pleaſure ordered it to be made publicly known, that every perſon who choſe to cultivate them were welcome to have a quantity for planting. In conſequence of this, numbers applied in our own and the adjacent counties. In my plantations, as well as thoſe of other perſons, the increaſe has been ſtill greater this year: for the ſeaſon having proved very favourable, I have had from ſome hillocks 42 pounds and a half, allowing for dirt."

We now continue our extracts from the Georgical Eſſays.

7 Of raiſing ſeedling potatoes.

"Take a bunch of the apples of any ſort of potato. Hang it up in a warm room during the winter, and in February ſeparate the ſeeds from the pulp, by waſhing the apples in water, and preſſing them with the fingers. Then dry the ſeeds upon paper. In the month of April, ſow theſe ſeeds, in drills, in a bed of earth well dug, and manured with rotten dung. When the plants are about an inch high, draw a little earth up to them with a hoe, in order to lengthen their main roots. When they are about three inches high, dig them up with a ſpade, and ſeparate them carefully from each other, in order for planting out in the following manner. Prepare a piece of freſh ground by trenching it well. Dig up the ſeedling plants as before directed; and plant them out in the ground, thus prepared, in ſuch a manner that there ſhall be 16 inches between each plant. As they advance in growth, let them receive one or two earthings up, in order to lengthen the main root, and encourage the ſhoots under ground. By this management, the potatoes will, in the courſe of one ſeaſon, arrive at the ſize of hen's eggs, and the haulm will be as vigorous as if ſets had been planted. But what proves the luxuriancy in the moſt convincing manner, is, that flowers and apples are produced.

"In Lancaſhire, where the gardeners raiſe potatoes from ſeed, they are always two, and ſometimes three, years in bringing them to full ſize. By the above method of tranſplanting, with wide diſtances, many of the potatoes nearly attain their full ſize in one ſeaſon. It is obſervable, that theſe ſeedlings produce potatoes of all the different kinds; and ſometimes new ſorts are procured. We do not find any difference whether the apple comes from one kind or another. It is not ſo when we uſe the ſet, which invariably produces the ſame kind. Potatoes, when propagated from ſets, after a number of years, are found to decreaſe in bearing; for which reaſon they ſhould be brought back every 14 years to their original. From a want of attention to this circumſtance, I have known potatoes ſo run out, that they hardly returned treble ſeed. The farmer complains that his land is tired of them; but the true cauſe

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(A) Inſtances of the amazing increaſe of potatoes are very numerous, and are almoſt every year detailed in the public papers. In the Gentleman's Magazine for 1757, p. 480, we are told, that from one ſlice of a potato, ſet in the ſpring of the ſame year by Mr Simon M'Hoy, a farmer at Park near Tuam in Ireland, there proceeded no leſs than 84 ſtalks, which produced 965 potatoes.

auſe is the age of the ſets. The increaſe of potatoes raiſed from ſeed is aſtoniſhing. They continue in vigour for about 14 years; after which the produce gradually declines.

8 On raiſing early potatoes. "As the culture of potatoes, and particularly of the early ſorts for the table, has of late become an object of very general attention, I hope the following account of a new method of obtaining theſe (without the help of hot-beds) will be acceptable to the public.

"On the 2d of January 1772, I made a hot-bed for the forward ſort of potatoes, and on the 7th put in the ſets, placing a glaſs and frame over them, and taking every precaution to defend them from the froſt. Of theſe ſmall potatoes, or ſets, there remained about 40 in a baſket, which was accidentally hung up in a warm kitchen, and there remained unnoticed till about the 25th of April. I then accidentally obſerved the baſket, and perceiving ſomething green on the edge of it, took it down, and, to my great ſurpriſe, found that the potatoes had ſprouted half a yard in length, and that there were a great number of very ſmall potatoes formed on the fibrous roots which had grown out. I took them into my garden, and planted them in a rich ſandy ſoil, without any manure. The roots I put into the ground three inches deep, and laid down the ſtems that had ſprouted, horizontally, and covered them with two inches of ſoil, but left the tops uncovered. Without further attention they grew ſurpriſingly.

"On the 26th of May, I took up the roots planted in the hot-bed on the 7th of January. They by no means anſwered my expectations, or paid for the trouble of their culture: but, at the ſame time, I was aſtoniſhed to find the others, which were put into the ground ſo late, to have produced larger potatoes than the roots in the hot-bed. I took up all the roots, and picked off the large potatoes from them, which amounted to from 4 to 12 on each root, and then ſet the roots again in the ſame ground. This, indeed, I have ſucceſsfully practiſed for many years, ſometimes even twice, and have had a third good crop at Michaelmas. When this method is tried, the roots muſt be watered on the evenings of hot days.

"In January 1773, in order to make a ſecond trial of this experiment with a large quantity, I placed a great many potatoes of the early ſorts on a thick layer of gravelly ſoil, cloſe to each other, over an oven, ſlated over, but open to the ſouth-weſt, and covered them two inches deep with the ſame earth. At the end of April I took them up, and found the ſtems about a foot long or more. For fear of injuring the fine and delicate fibres of the roots, I took great care in taking them up, and planting them in the ſoil. This I now manured, but in all other reſpects treated them in the manner above deſcribed, many of the fibrous roots having then potatoes formed upon them nearly as large as walnuts. For a week, the plants came on ſurpriſingly, when, by one ſharp night's uncommon froſt, they were nearly deſtroyed. However, notwithſtanding this, freſh ſtems grew up in a few days, and I actually gathered from them, on the 3d of June following, finer potatoes than were ſold at that time, at Mancheſter, from 1 s. to 1 s. 6 d. per pound, being the produce of hot-beds. After taking off the larger potatoes, I again planted the roots for a ſecond crop, and in September obtained a very large produce. I weighed the increaſe of many ſeparate roots, which amounted from four pound eight ounces to 14 pound 12 ounces, the potatoes being the largeſt of the forward kinds I ever ſaw.

9 On raiſing them in winter. "Make a compoſt of earth, ſand, and coal-aſhes. With this mixture fill a tub about 16 inches deep. Plant this artificial ſoil with ſome ſets of the early round potato, and place the tub in a ſtable oppoſite to a window, taking care to water the earth now and then. In all ſeaſons the ſets will ſprout, and give a tolerable increaſe of potatoes. Laſt November I planted ſome ſets in the above manner; and in February following I took up a conſiderable number of young potatoes, clean ſkinned and well flavoured.

10 On tranſplanting potato-tops. "On the 18th of May 1772, finding ſome beds I had ſown very early with onions to be a miſſing crop, I was induced to make the following experiment. The year before, I had ſet ſome potatoes in another part of my garden in the common way; and as it is impoſſible but ſome will remain in the ground all winter, ſo I found a number of ſprouts about three inches high, which I nipped off cloſe to the ground, and tranſplanted them into the onion-beds, without any further preparation, about a foot and a half aſunder, in the ſame manner that cabbages and cauliflowers are planted. As the ſeaſon became immediately very dry, I was obliged to give my plants a little water for four or five ſucceſſive nights; after which they began to flouriſh, and had the appearance of a promiſing crop during all the ſummer. At the uſual time, in October, I ordered them to be taken up; and for ſize, quantity, and quality, they exceeded all I ever had in the common way. Had the ground been freſh, properly manured and prepared, and the plants put down at a proper diſtance from each other, I am of opinion that the ſucceſs would have been ſtill greater.

11 On feeding hogs, &c. with potatoes. "From an accurate experiment made laſt year, I dare venture to recommend baked potatoes as an excellent food for hogs. The pork produced by this food was equal to that from barley and beans: but at preſent I cannot exactly aſcertain the comparative experiment with regard to expence; however, I am of opinion, that roaſted potatoes, conſidering the improvement of the hogs, is as cheap a food, if not cheaper, than can be given them. I roaſted my potatoes upon a kiln, ſimilar to what is uſed by oatmeal ſhellers for drying their oats. The difference in expence between boiling and roaſting the potatoes is prodigious, both with regard to the labour and fuel. A kiln that will coſt 3 l. will roaſt potatoes ſufficient for the maintainance of more than 20 hogs; and one man will beſtow all the neceſſary attendance upon them, and do other work beſides. The action of the fire, by diſſipating the crude juices that are contained in raw potatoes, reduces them into a ſtate highly wholeſome and nutritious. Boiling does this in part, but not ſo effectually. A potato roaſted in the manner above deſcribed, partakes much of the nature of a cheſnut, and perhaps is not greatly inferior to it."

Potatoes are found to be uſeful food for moſt other animals. See Agriculture, n° 45.

To theſe experiments we ſhall add ſome important obſervations of Dr Anderſon of Cotefield near Leith, 12 Remarks on the ſeeds moſt proper to be planted.

who has paid a very particular attention to this as well as other branches of agriculture. Our readers will find the Doctor's remarks and experiments at large in the *Bath Papers*, volume fourth. He firſt conſiders the nature of the ſeeds moſt proper to be planted; and from his experiments he thinks it appears that the produce is not materially affected, by planting for ſeed, either whole potatoes or cuttings, or large or ſmall potatoes as ſuch; for it is only incidentally that theſe things can affect the crop. In the fifth volume of the *Bath Papers*, Mr Wimpey relates an experiment, by which it would appear that there is an advantage in planting cut potatoes. His concluſion is as follows. "The meaſure of all the ground planted, ſays he, was 325 poles; the whole produce 378 buſhels. The meaſure of the ground planted with cut potatoes was 265 poles; the produce 312 buſhels The ground planted with whole or uncut ſets was 60 poles, and the produce of the ſame 66 buſhels. Now, if 48 buſhels, the whole quantity of ſets uſed, produced 378 buſhels, then 34 buſhels, the quantity cut, ſhould produce 267 buſhels; but they produced 312, which is 45 buſhels more than the proportion. Again, if 48 buſhels produced 378 buſhels, then 14 buſhels ſhould have produced 110 buſhels; but 14 buſhels of uncut produced only 66 buſhels, which is 44 buſhels leſs than the proportion. A preference of 40 *per cent.* in favour of cut potatoes, in compariſon with whole ſets." Mr Wimpey corroborates the fact in the ſixth volume of the ſame work, and informs us, moreover, that he uſed to ſupply many of his neighbours with potatoes for planting; ſome of whom deſired to have them all ſmall as they had found them equally productive with the larger, and ſaved much trouble in cutting. "Others (continues he) preferred the largeſt, who carried their economy much further: they, it ſeems, uſed to pare them, eat the fleſhy part, and plant the rinds only. Upon inquiry, I found it was not an unuſual practice among the cottagers; and I have been credibly informed they get as large crops and as good potatoes in that method of planting as in any other whatever. If this be a fact, it ſeems to appear that the fleſhy part of the bulb is of no uſe in ſupplying nouriſhment to the young fruit after the fibrous roots have put forth and laid hold of the ground. Perhaps an experiment of this ſort may be thought worth making. "The weight of the crop, however, Dr Anderſon aſſerts (and Mr Wimpey agrees with him, ſee Bath Papers, vol. v. p. 34.), is always in ſome meaſure influenced by the weight of the ſeeds planted; but the weight of produce is not augmented in the *ſame proportion* with the weight of the ſeed planted; the ſmalleſt ſeed yielding the greateſt returns in proportion to the ſeed, but the ſmalleſt in proportion to the extent of ground. It is in no caſe profitable, however, the Doctor thinks to plant ſmall potatoes (B), or ſmall cuttings, unleſs where it is meant to increaſe as faſt as poſſible a favourite kind; in which caſe it may be ſometimes eligible to plant pieces very ſmall, as in that way the kind will be moſt quickly multiplied. We may alſo remark here, that ſuch as wiſh for a large increaſe ſhould never plant the worſt of the crop; it is, we know, extremely common, and may indeed be an immediate ſaving; but it is unqueſtionably a loſs upon the whole; and perhaps it is one cauſe of the *curl diſeaſe*, which is the ſure indication of a poor dwindling crop, and of which we ſhall ſpeak more at large immediately.

Our author further remarks, that there ſeems to be no reaſon to ſuſpect that eyes taken from any particular part of the bulb are poſſeſſed of a degree of prolificacy greater than thoſe taken from any other part of it, independent of the ſize of the fleſhy part that adheres to the eye. It is however highly probable that a difference in the crop, either with reſpect to the number and ſize, or general weight of the whole, would reſult from planting large cuttings of equal weight, taken from the big end of large potatoes, or from the point, as many eyes would be in the laſt in compariſon of the firſt. This is therefore one of the many preparatory experiments that require to be made. It is poſſible too that even the apples may be an object of value, and may indicate a thriving crop or otherwiſe; but of this there is no certainty, as no ſpecific experiments have yet been made on this ſubject.

13 On cutting the ſtems of potatoes while growing.

With reſpect to the effects of cutting the ſtems of potatoes while growing, the Doctor ſeems to be doubtful. The ſtems of potatoes, if cut while growing, and uſed green, are found to be a wholeſome food for cattle, and horſes. But though ſome farmers maintain that the produce in potatoes it not leſſened by having the ſtems cut off while they are in ſtate of vigorous vegetation; others as poſitively inſiſt that the crop is eſſentially injured by that operation. It is proper that this point ſhould be aſcertained. Probably the crop is hurt if the ſtems are cut over before they have attained a certain point of maturity, though it is poſſible they may be afterwards cut without doing any eſſential injury to it.

14 On extracting ardent ſpirits from potatoes.

We have already mentioned that an experiment was made a good while ago in Sweden, to extract ardent ſpirits from potatoes. Other experiments have been made in this country of a later date, but with little effect. This, however, appears to have proceeded either from ignorance or a want of proper attention to the fermentation and after-diſtillation; as appears from Dr Anderſon's experiment, which ſucceeded extremely well by attending to theſe proceſſes. What he made he aſſerts to have been the fineſt and moſt agreeable vinous ſpirit he ever ſaw, reſembling in taſte very fine brandy, but more mild, and having a certain coolneſs on the ſtomach peculiar to itſelf.

Much may be done in bringing potatoes to pefection

(B) In oppoſition to this, it is the opinion of even practical men, that the ſmall potatoes are to be preferred. "I have been informed (ſays Mr Hollins) by a native of America, that what we call the long red American potato, grows in that rich and newly cleared ſoil to a very large ſize; but that the potatoes proceeding from the roots were never uſed as ſeed; for there ſprung from the ſtalk, very near the ſurface of the ground, ſmall potatoes as they called them; but, he ſaid, they were about the ſize of thoſe raiſed in England, and thoſe were always planted. I hope the Society will forgive my mentioning this, as it confirms what I have already ſaid, 'that ſmall potatoes are beſt for ſeed." *London Society of Arts*, vol. xi. p. 82.

tion by attending to their ſeveral varieties. For this purpoſe ſome particular potato muſt be fixed upon as a ſtandard; and when this is done, the inquiry muſt be carried on by attending, *firſt*, to their appearances below ground, as, 1. the general form and ſize of the bulbs; 2. their colour; 3. the ſmoothneſs or roughneſs of the ſkin; 4. the conſiſtence, that is, the mealineſs or viſcoſity and taſte of the bulb; 5. the colour, length, thickneſs, &c. of the umbilical cord; 6. their tendency to grow deep, or to riſe near the ſurface; to ramble wide, or to adhere cloſe to the ſtem; 7. the time when the bulbs knot and ſet; marking, not by the kalendar only, but alſo compared with the advance of the plant above ground; 8. the time when they attain perfect maturity with reſpect to ſize, and alſo that period of their growth at which they loſe the herbaceous, and attain the farinaceous, taſte; 9. their general prolificacy; 10. how long they may be kept, at what ſeaſon they are in greateſt perfection for eating, &c. We muſt *next* attend to the particulars obſervable above-ground; as, 1. the general height, colour, and form of the ſtem; 2. their tendency to puſh out many or few ſtems from a root; 3. whether they carry bloſſom or not; 4. the form, dimenſions, and colour of the leaves; 5. the form, colour, and general habitude of the bloſſom where there is any; 6. the time at which the bloſſom appears; 7. the tendency they have to produce few or many apples; 8. the tendency they have to produce thoſe excreſcences on the ſtalks that reſemble potatoes below ground, which may be called air potatoes; 9. the comparative hardneſs or tenderneſs of the leaves, in reſpect of froſt or other variations of weather that affect them. And, *laſtly*, we muſt attend to the particulars that concern the whole plant; as, 1. the ſoil which ſeems beſt to ſuit each kind; 2. the mode of culture that beſt agrees with them; 3. the accidents which are moſt liable to affect them; and in general every particular that could indicate any difference between one kind and another.

15 On attending to the ſeveral varieties of potatoes.

16 Opinions on raiſing ſeedling potatoes.

Our author next conſiders the circumſtance of raiſing ſeedling potatoes. His mode of raiſing them was ſimilar to that recommended in the *Georgical Eſſays* quoted above; but he differs with reſpect to the utility or ſucceſs of that mode. It has been alleged, he ſays, that potatoes, which have been long propagated by means of bulbs, loſe in time their generative quality, ſo as to become much leſs prolific than at firſt; and it is aſſerted that thoſe bulbs which have been lately obtained from ſeeds are much more prolific, and conſequently much more profitable for being employed as plants than others: but this opinion appears to have been adopted without ſufficient examination: for there appears not the ſmalleſt indication of ſuperior prolificacy in thoſe raiſed from ſeeds, but rather the reverſe. That potatoes do not degenerate in point of prolificacy in conſequence of being long propagated in the uſual way, ſeems to be confirmed by the general experience of all Europe. It is now about a hundred years ſince the potato was pretty generally cultivated in Ireland, and it has been very univerſally cultivated in Britain for 50 years paſt; and all that have been reared in it ſince their firſt introduction two hundred years ago, a very few of late only excepted, have been propagated from bulbs only; ſo that if they have declined in point of prolificacy, the degeneracy ſhould in this time have been very apparent. Nothing of that kind however was ever remarked, nor any inſinuation of that ſort thrown out, till the diſcovery of rearing potatoes from ſeed was made, when it was for the firſt time heard of. There are many perſons now living who have been in the conſtant practice of rearing potatoes for 30 or 40 years; and notwithſtanding the general tendency that mankind have to diſpraiſe the preſent, when compared to paſt times, yet none of them have given the ſmalleſt hint of degeneracy in this reſpect. And perhaps it will be found that this is merely a groundleſs notion, that has originated from the partial fondneſs of thoſe who firſt propagated this plant from ſeed, in favour of their new diſcovery. It has been further ſaid, that by raiſing potatoes from ſeed, many new and valuable kinds may be obtained; and it is alſo aſſerted in the *Georgical Eſſays*. Indeed an opinion of obtaining new varieties of plants by propagating them from ſeed univerſally prevails among naturaliſts. But Dr Anderſon, in his firſt paper, doubts whether this be fact, and whether, when any of theſe occur, they have not been the effect of accidental poſition or other cauſes. We may certainly (ſays he) aſſert on the whole, that if the practice of rearing potatoes from ſeeds ſhall ever be productive of any advantages to ſociety, they have not yet been diſcovered. Since he wrote that treatiſe which appears in the Bath Papers, vol. iv. (and of which we are now giving a ſhort account), however, he has had occaſion to alter his opinion, which he does with great candour in vol. v. The experiment which induced him to alter his opinion, and which appears to be deciſive, was made with the ſeed of a potato procured from Ireland of a very peculiar kind. Its colour was a dirty dark purple, its ſhape a round irregular bulb, and its ſtem tall and upright. The ſeeds procured from this potato were ſown by themſelves, and the ſeedlings when of a proper ſize were tranſplanted. From the appearance of the ſtems he ſoon diſcovered that they were not all of one ſort, and on taking them up the variety was almoſt infinite; and ſuch as could not be accounted for on the principles of a mongrel adulteration. The diverſities reſpected colour, ſhape, &c. ſome of which he enumerates. See *Bath Papers*, vol. v. p. 127.; ſee alſo p. 35. where Mr Wimpey controverts the Doctor's former opinion.

17 On the curled diſeaſe.

Reſpecting the cauſes and prevention of the *curled diſeaſe* in potatoes there has been a great variety of opinions, which we have detailed at ſome length under the article Agriculture, p. 267 to 270. Dr Anderſon confeſſes that he can ſay but little *poſitive* as to the cauſe of this diſorder, but he thinks a good deal may be ſaid on the *negative* ſide of the queſtion. It was little known till lately (c), and in the northern parts of Britain it was abſolutely unknown but a very few years ago: and even now in the more remote corners it is ſtill leſs frequent than in the more ſouthern and more commercial diſtricts of the iſland. It has been ſuppoſed that nature, ſated as it were by having long produced this plant in a climate not deemed congenial to it, had become ſo far exhauſted as to occaſion this diſeaſe. But in this caſe, the more northern parts, where the climate is moſt unfavourable, ſhould have been ſooneſt affected. It has been alſo thought that potatoes, whoſe bulbs are froſt-bitten before they are houſed, occaſion this diſeaſe in the plants they produce. But the fact is, that they are leaſt liable to the diſeaſe in thoſe diſtricts where they are moſt expoſed to froſt. A potato can never indeed be benefited by froſt; but it is not at all probable that the being touched by it occaſions the curl. The taking up potatoes before they arrive at maturity has been thought to occaſion the diſeaſe; but in places where they muſt be taken up ſo, the diſeaſe is ſcarcely known. It has alſo been thought that potatoes obtained from *ſeed* are entirely free from it. But Dr Anderſon gives a proof of the contrary; for one half of the plants of a large field planted from potatoes the third year from the ſeed were curled; while another field adjoining raiſed from potatoes that never were, that he knows, produced from ſeed in Britain, had ſcarcely one curled plant in the whole. The diſeaſe has been ſuppoſed by others to ariſe from the ſoil or ſeaſon. But that this is not the caſe, appears from the circumſtance of a ſingle field which Dr Anderſon planted with potatoes of the very ſame ſort, but obtained from different perſons. The ridges were intermixed, and the one was very much curled, and the other perfectly free. The diſeaſe, therefore, appears to ariſe from infected ſeed: it is however poſſible that it may be communicated by juxtapoſition; and if ſo, the diſeaſe might be in a great meaſure if not entirely avoided, by pulling out thoſe that ſhowed the leaſt ſymptom of it, on their firſt appearing above ground.

(c) In the eighth volume of the Tranſactions of the London Society for Encouragement of Arts, &c. p. 43. we are told that the curl firſt appeared in 1764, in the very diſtrict in Lancaſhire where they were firſt cultivated.

In the Tranſactions of the London Society for encouragement of arts, &c. we find a good deal about the curl diſeaſe. Many of the writers agree in opinion with Dr Anderſon in many particulars; and particularly, that though the diſeaſe may be prevented, we do not yet know enough of its nature to be able to cure it. See their vol. viii. p. 18, &c. ix. p. 52, &c. and x. p. 75. In this laſt volume we are told that the principal cauſes of the curl are three: 1. From their being forced by cultivation to overgrow their power for vegetation; 2. From their vegetative power being dried up in ebb ſoil by the ſcorching heat of the ſun; and, 3. From their being expoſed too long after they are cut in ſets before they are planted.

18
On the ſoil and ſeaſon moſt proper for potatoes.

It is generally and very naturally believed that a dry ſoil or a dry ſeaſon neceſſarily produces the drieſt potatoes. But there is good reaſon to doubt the truth of the opinion. The year 1775 was the drieſt and warmeſt ſeaſon that has been known in Scotland within the memory of man, yet the potatoes of that year's crop were watery almoſt to a proverb: on the other hand, the potatoes of crop 1777, although it was a remarkably rainy ſeaſon, were as dry and mealy at leaſt as is common, and much more ſo than in the year 1775. It deſerves alſo to be remarked, that the crop of 1775 was almoſt double in quantity to that of 1777. Hence a dry ſeaſon would ſeem to augment the produce, though it does not for certain in all caſes improve the quality, of this crop: nor does a dry ſoil neceſſarily inſure meally potatoes; for our author ſays he has often ſeen potatoes of the ſame kind, and of the ſame year's produce, reared in two different places; the one of them in a naturally damp ſoil, which turned out to be much freer and more mealy than the others which were reared on a drier and ſharper ſoil. He confeſſes, that he has alſo often ſeen it turn out in fact, that potatoes raiſed in thoſe diſtricts where the ſoil is hot and ſandy, are uſually more free and tender than thoſe raiſed in countries where the ſoil is cold and damp. Our author tries to account for theſe contradictory phenomena by conjecturing the probable cauſe of the waterineſs or dryneſs of a crop. He aſks, Whether in this reſpect the crop is anywiſe affected by the degree of ripeneſs that the plants employed for ſeed may have attained in the preceding ſeaſon? That this is the caſe he thinks highly probable. Potatoes which, on account of the richneſs or other peculiarity of the ſoil, continue in a ſtate of vegetation highly luxuriant till they are nipped by froſt, or checked in their growth by other inclemencies of the ſeaſon, have much leſs chance of being dry and mealy than others of the ſame ſort which have attained their full growth before the coldneſs or inclemency of the weather checked them. But our author's queſtion does not relate to this, but to the effect theſe unripe potatoes, uſed as ſeed, would have on the ſucceeding crop; a circumſtance which experience alone can determine. "But even if it ſhould be found (continues our author) that the maturity of the ſeeds affected the quality of the potatoes, it would not follow invariably that the ſeeds produced on early dry ſoils would be better than thoſe from later ſoils; becauſe it might ſometimes happen from local poſition, and other accidental circumſtances, that the growth of the potatoes in the dry early ſoil might be checked by froſts many weeks before thoſe on the other ſoil were affected, in conſequence of which the plants in the cold ſoil might attain to more perfect maturity than thoſe on the drier one. I mention this peculiarity merely to ſhow how cautious the farmer ought to be in adopting general concluſions without carefully attending to all the collateral circumſtances that may affect his experiment. I ſhall only farther add on this head, that I had occaſion to know well a dry warm ſpot of ground on which the ſtems of the potatoes of crop 1776 were froſt-bitten at leaſt *ſix weeks* before thoſe on another ſpot at ſome miles diſtance from it, where the ſoil was naturally more cold and damp, were in the ſmalleſt degree affected by it. It likewiſe ſo happened, that the potatoes raiſed on the firſt-mentioned ſpot in the year 1777 (their own froſt-bitten (D) ſeed was employed) had ſuch a peculiar acrid and bitteriſh taſte as to be hardly at all eatable, while thoſe in the colder place of that crop had nothing of that unuſual

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(D) Obſerve, the term *froſt bitten* is here applied to the ſtems only, and not to the bulbs. The ſtems were ſo much hurt by the froſt as to turn black and decay, but the bulbs were taken up before the froſt had been ſufficiently intenſe to hurt them.

uſual taſte. Whether this diverſity was occaſioned by the circumſtance here alluded to, I do not take it on me to ſay. In matters of ſuch nice diſquiſition as the preſent, many facts obtained by very accurate obſervation are neceſſary before any concluſion can be relied on."

Potatoes, when planted in water, ſhoot out a great number of fine white roots like threads into the water; but on none of them is there to be found the leaſt appearance of a bulb; while on the other hand the potatoes in that caſe always grow on the top. Potatoes are found to be extremely uſeful in bringing exhauſted land into heart again. See AGRICULTURE, n° 35 and 186, p. 309, col. 1. The biſhop of Killalue in Ireland directs the uſe of them for this purpoſe in a letter in the *Bath Papers*, vol. 4. p. 232, and confirms its utility in this reſpect by experiments of his own. In the 10th vol. of the *Tranſactions of the London Society for Encouragement of Arts*, &c. p. 34, there is alſo a moſt deciſive proof of this utility.

We have been induced, from the extenſive utility of this root, to extend our obſervations on the ſubject to a greater length than we ſhould otherwiſe have done. Such of our readers as wiſh for further information, will of courſe conſult the books from which we have made up the preſent article, as well as other books on Agriculture; in which they will find the obſervations and experiments which we have mentioned at much greater length than we could poſſibly give them. In the ſixth volume of the *Bath Society Papers* there is an excellent paper on the culture of potatoes and feeding hogs with them during ſeven years by John Billingſley Eſq; of which our limits do not permit us to take particular notice. There are alſo a variety of other papers in the ſeveral volumes of that work, as well as in the Tranſactions of the London Society, which we have already ſeveral times mentioned; which will deſerve the particular attention of ſuch as wiſh well to the poor, or have a deſire ſtill farther to extend the utility of this moſt valuable root. We have already mentioned a cheap preparation by means of potatoes for the poor, ſee AGRICULTURE, n° 161; and we ſhall finiſh the preſent article with a receipt to make a potato herrico, which may be equally uſeful to thoſe whoſe circumſtances are not ſuch as to make them regardleſs of economy. We take it from the Gentleman's Magazine, and give it in the words of a perſon who had tried the experiment.

Scrape the ſkin clean off four pounds of good raw potatoes, then waſh them clean in fair water: take two pounds of beef, one of mutton, and one of pork; or as you like beſt, four pounds of any of theſe meats; cut them into pieces of three or four ounces each, ſeaſon them very well with pepper and ſalt and a good onion chopped very ſmall: have ready a ſtrong wide-mouthed ſtone-jar, ſuch as hares are uſually jugged in; ſlice thin a layer of the potatoes into the jar, then a layer of the ſeaſoned meat over them, and ſo alternately layers of potatoes and meat; let your uppermoſt layer be potatoes, ſo that your jar be about three quarters full, but put no water into your jar; then cloſe or ſtop the mouth of it with a large well-fitted piece of cork, covering the ſame with a ſtrong piece of canvas, and tyeing it down with pack-thread, ſo as only a little of the ſteam may eſcape in the ſtewing; for a little ſhould conſtantly evaporate from the ſide of the cork to ſave the jar from burſting. Then place your jar upright in a kettle of cold water on the fire, ſo as the mouth of the jar may be always two inches above the water in the kettle when boiling. The herrico in the jar will begin to boil ſome minutes ſooner than the water in the kettle, and that for obvious reaſons. In about an hour after the water in the kettle begins to boil, your herrico will be fully ſtewed. Then take out and open the jar, pour out the herrico into a deep diſh, and ſerve it up.

This excellent, wholeſome, and economical diſh ſupplies an agreeable dinner twice a week to a family conſiſting of three grown people, and three children under fourteen years of age, where neither health nor good ſtomachs are wanting, thanks to God: and, in point of economy we muſt obſerve, that here is the whole article of butter ſaved, as alſo the whole article of bread, or nearly ſo; nor does there require ſo large or ſo continued a fire, nor ſo much time or trouble as is neceſſary for the dreſſing of many other diſhes that by no means deſerve the preference of this excellent herrico.

We have alſo (by way of change) made it with powdered beef, ſometimes with powdered pork, ſometimes with half freſh beef or mutton and half pickled pork, and found it good in all theſe ways, particularly with three pounds of freſh beef and one of pickled pork. We have left off ſending pies and ſtews to the bakers. We ſometimes (in a larger kettle) boil a ſmall piece of powdered beef along-ſide of the jar, by continuing the boiling an hour and an half longer, and this ſerves us to eat cold the next day, with hot garden-ſtuff or a pudding.

POTATO-Bread. See *BREAD of Potatoes.*

Spaniſh POTATO. See CONVOLVULUS, n° 5.

POTENT, or **POTENCE**, in heraldry, a term for a kind of croſs, whoſe ends all terminate like the head of a crutch. It is otherwiſe called the *Jeruſalem croſs*, and is repreſented Plate CCXXIX, fig. 12, 12.

POTENTIA (POWER), that whereby a thing is capable either of acting or being acted upon.

POTENTIAL, in the ſchools, is uſed to denote and diſtinguiſh a kind of qualities, which are ſuppoſed to exiſt in the body *in potentia* only; by which they are capable in ſome meaſure of affecting and impreſſing on us the ideas of ſuch qualities, though not actually inherent in themſelves; in which ſenſe we ſay, potential heat, potential cold, &c.

POTENTIAL Cautery, in medicine, denotes the conſuming, or reducing to an eſchar, any part of the human body by a cauſtic alkaline or metallic ſalt, &c. inſtead of a red-hot iron, which laſt is called the *actual cautery*.

POTENTIAL, in grammar, an epithet applied to one of the moods of verbs. The potential is the ſame in form with the ſubjunctive, and is, according to Ruddiman, implied in that mood, for which reaſon that grammarian rejects it; but others will have it to differ from the ſubjunctive in this, that it always implies in it either *poſſum*, *volo*, or *debeo*. It is ſometimes called the *permiſſive mood*, becauſe it often implies a permiſſion or conceſſion to do a thing. See GRAMMAR.

POTENTILLA, SILVER-WEED, *wild tanſey*, or *cinquefoil*: A genus of the pentagynia order, belonging to the icoſandria claſs of plants; and in the natural method ranking under the 35th order, *Senticoſæ*. The calyx is decemfid; there are five petals; the ſeeds roundiſh, naked, and affixed to a ſmall dry receptacle. The ſpecies are, 1. The fruticoſa, or ſhrubby potentilla, commonly

monly called *ſhrub-cinquefoil.* This riſes with a ſhort ſhrubby ſtem, dividing into a branchy full head, three or four feet high; cloſely garniſhed with pinnated leaves of five oblong, narrow, acute-pointed, folioles, pale green above, and whitiſh underneath; and the branches terminated by cluſters of large ſpreading, yellow flowers. This is a beautiful deciduous flowering ſhrub, worthy a place in every curious collection. It grows wild in Yorkſhire and other northern parts of England, &c. but has been long cultivated in gardens as an ornamental ſhrub. 2. The reptans, or creeping common five-leaved potentilla, or five-leaved graſs, hath a thick fibry root, ſlender, trailing, repent ſtalks, digitated, five-lobed, petiolated leaves, and yellow flowers ſingly. 3. The rupeſtris, or mountain upright cinquefoil, hath upright ſtalks, eight or nine inches high; pinnated five and three lobed alternate leaves, having oval crenated lobes, and the ſtalks terminated by ſmall white flowers. 4. The recta, or erect ſeven-lobed yellow cinquefoil, hath erect ſtalks, ſeven-lobed leaves; having three lobes ſpear-ſhaped and ſerrated, green and hairy on both ſides, and the ſtalks terminated by corymboſe cluſters of yellow flowers. 5. The fragaroides, or ſtrawberry-like trailing potentilla, hath a ſomewhat tuberous root, furniſhed with many long fibres, long trailing ſhoots, rooting at the joints; pinnated, moſtly three-lobed leaves, having oval lobes, with the extreme lobe the largeſt, and cluſters of ſmall white flowers. This ſpecies bears a great reſemblance to the ſmall ſterile ſtrawberry plants. 6. The argentea, ſilvery upright potentilla, hath upright ſtalks, branching a foot high; and five-lobed leaves, having the lobes wedge-ſhaped, cut on the edges, hoary and white underneath, and the branches terminated by ſmall yellow flowers.

All theſe plants flower in June and July; the flowers are compoſed each of five roundiſh petals, and about 20 ſtamina. They are all very hardy, and may be employed in the different compartments of the pleaſure ground. Their propagation is very eaſy. The ſhrubby potentilla may be propagated abundantly by ſuckers, layers, and cuttings; all of which will readily grow, and make plants in one year, which after having two or three years gowth in the nurſery will be fit for any of the ſhrubbery compartments. All the herbaceous kinds may be propagated by parting the roots in autumn or ſpring, or by ſeed in any of thoſe ſeaſons.

POTERIUM, GARDEN BURNET: A genus of the polyandria order, belonging to the monœcia claſs of plants and in the natural method ranking under the 54th order, *Miſcellaneæ*. The male calyx is tetraphyllous; the corolla quadripartite; and there are from 30 to 40 ſtamina. The female calyx is tetraphyllous; the corolla quadripartite; there are two piſtils; the berry is formed of the indurated tube of the corolla. The ſpecies are, 1. The ſanguiſorba, or common garden burnet, hath fibry perennial roots, crowned by a large tuft of pinnated leaves, or ſix or ſeven pair of ſawed lobes, terminated by an odd one; upright angular ſtalks, dividing, and branching a foot and a half high, terminated by oblong ſpikes of purpliſh red flowers. This ſpecies grows wild in England, in chalky ſoils; but has been long cultivated as a choice ſalad-herb for winter and ſpring uſe, it being of a warm nature; the young leaves are the uſeful parts. It is perennial in root, and retains its radical leaves all the year, but the ſtalks are annual. 2. The hybridum, hybrid agrimony-leaved Montpelier burnet, riſes with upright, taper, cloſely gathered ſtalks two feet high; pinnated odoriferous leaves of three or four pair of ſawed lobes, terminated by an odd one; and the ſtalks terminated by long footſtalks dividing into ſmaller, each ſupporting a ſmall roundiſh ſpike of flowers. This ſpecies often proves biennial; but by cutting down ſome of the ſtalks before they flower, it will cauſe it to multiply at bottom, and become abiding. 3. Poterium ſpinoſum, ſhrubby ſpinous burnet of Crete, hath a ſhrubby ſtem and branches, riſing a yard high, armed with ſpines; ſmall pinnated evergreen leaves, of ſix or ſeven pair of lobes, terminated by an odd one, and the branches terminated by ſmall heads of greeniſh flowers.

All theſe ſpecies flower in June and July, ſucceeded by ripe ſeeds in Autumn. They are all naturally perennial; but the two herbaceous ones are abiding in root only; the other in root, ſtem, and branches: the two former are hardy, and the third requires ſhelter in winter. The firſt ſort merits culture in every kitchen-garden for winter and ſpring ſalads. Some plants, both of the firſt and ſecond ſorts, may be introduced in the herbaceous collection in the pleaſure-garden for variety. The third ſort muſt be kept always in pots to have ſhelter in winter. They are all eaſily propagated, the firſt ſort by ſeed and by parting the roots. The ſecond ſort may alſo be increaſed by ſeeds and ſlips of the root, as for the former ſort. And the propagation of the third is by ſlips or cuttings of the branches in ſpring and ſummer, planted in pots, and placed under glaſſes, giving ſhade and water; or might be forwarded more by plunging them in a hot-bed.

Burnet is of a heating, drying nature, cordial and alexipharmac; in ſummer, the leaves are uſed for cool tankards, to give the wine an agreeable flavour. The powder of the root of the firſt ſpecies is commended againſt ſpitting of blood, bleeding at the noſe, dyſenteries, and diſeaſes attended with violent ſecretions. In winter and ſpring, the young tender leaves are uſed in ſalads. For its uſes as food for cattle, ſee AGRICULTURE, nº 184

POTHOS, in botany; a genus of the polyandria order, belonging to the gynandria claſs of plants. The ſpatha or ſheath is a ſimple ſpadix covered; there is no calyx but four petals, and as many ſtamina; the berries diſpermous.

POTION, a liquid medicine, conſiſting of as much as can be drunk at one draught.

POTIPHAR, or PUTIPHAR, an officer of the court of Pharaoh king of Egypt, and general of his troops, according to our tranſlation, Le Clerc, and the verſion of the vulgate; but according to the Hebrew and Septuagint, the chief of his butchers or cooks. The Hebrew text, the Septuagint, and vulgate, call him Eunuch. But it is probable it in this place means only an officer of the king's court, for he was certainly married and had children. We have no other accounts of him but what appear in ſcripture; and that account is too generally known to require to be enlarged on in this place. See Geneſis xxxviii. xxxix. &c.

POTOSI, a city of Peru in South America, ſituated at the bottom of a mountain of that name, in which is the richeſt ſilver mine ever diſcovered. To give an idea of its richneſs, we ſhall mention its produce at different times. Excluſive of what was not regiſtered, ſays Abbé Raynal, and was ſmuggled away, the fiſth part belonging to the government, from 1545 to 1564, amounted to 36,450,000 livres * *per annum*. But this abundance of metals ſoon decreaſed. From 1564 to 1585, the annual fifth part amounted to no more than 15,187,489 livres four ſols §. From 1585 to 1624, it amounted to 12,149,994 livres 12 ſols †. From 1624 to 1633, to 6,074,997 livres ſix ſols ‡. From this laſt period, the produce of theſe mines hath ſo evidently decreaſed, that in 1763 the fiſth part, belonging to the king, did not exceed 1,364,682 livres 12 ſols ||. Situated in W. Long. 67. S. Lat. 22. See the article Peru, p. 220, col. 2.

POTSDAM, or **Postdam**, a town of Germany, in the circle of Upper Saxony, with a palace, belonging to the king of Pruſſia. It is ſeated in an iſland ten miles in circumference, formed by the rivers Sprae and Havel. The palace is very curious, and finely built upon a delightful ſpot 12 miles weſt of Berlin. E. Long. 13. 42. N. Lat. 52. 34. Reiſbeck in his travels informs us, that the houſes in Potſdam are ſtill finer than thoſe of Berlin; but like them they are inhabited only by perſons of the lower and middling ranks.

POTT (Percival), was born in London in 1713. He received the firſt rudiments of his education at a private ſchool at Darne in Kent; and became an apprentice to Mr Nourſe, one of the ſurgeons of St Bartholomew's hoſpital; of which hoſpital, in 1744-5, he was elected an aſſiſtant ſurgeon, and in 1749 appointed one of the principal ſurgeons. In 1746, he married the daughter of Robert Cruttenden, Eſq. His firſt publication is ſaid to have been planned in 1756, during his confinement in conſequence of a compound fracture of the leg: from that time, his pen was ſeldom long unemployed. His practice and his reputation were now rapidly increaſing: in 1764, he was elected a fellow of the Royal Society; and afterward was complimented with honorary diplomas from the Royal Colleges of Surgeons at Edinburgh and in Ireland. In 1787, he reſigned the office of ſurgeon to St Bartholomew's hoſpital, "after having ſerved it (as he uſed to ſay), man and boy, half a century; and on the 22d of December 1788, after an illneſs of eight days, he expired.

"The labours of the greateſt part of his life (ſays Mr Earle, who publiſhed his Chirurgical works), were without relaxation: an increaſing family required his utmoſt exertion: of late years he had a villa at Neaſden; and in the autumn uſually paſſed a month at Bath, or at the ſea-ſide. Thus, though he gathered, as he expreſſed it, ſome of the fruit of the garden which he had planted as he went along, and always lived in a generous and hoſpitable manner, at the ſame time beſtowing on four ſons and four daughters a liberal and neceſſarily expenſive education, and applying large ſums to their eſtabliſhment during his lifetime, he left an ample proviſion for them at his deceaſe. Among his papers was found, what he had often mentioned, a ſmall box, containing a few pieces of money, being the whole which he ever received from the wreck of his father's fortune. With this was depoſited an exact account of every individual fee which a long life of buſineſs had produced—abundant evidence of well ſpent time, and the induſtrious application of abilities, to which the *res anguſta domi*, at the commencement probably acted more powerfully as an incentive than as an obſtacle."

POTTER (Chriſtopher), a learned Engliſh divine, was born in 1591, and bred at Oxford. In 1633, he publiſhed his "Anſwer to a late Popiſh Plot," intitled *Charity miſtaken*, which he wrote by ſpecial order of King Charles I. whoſe chaplain he was. In 1634, he was promoted to the deanery of Worceſter; and, in 1640, was conſtituted vice-chancellor of the univerſity of Oxford, in the execution of which office he met with ſome trouble from the members of the long parliament. Upon breaking out of the civil wars, he ſent all his plate to the king, declaring, "that he would rather, like Diogenes, drink in the hollow of his hand, than that his majeſty ſhould want;" and he afterwards ſuffered much for the royal cauſe. In conſideration of this he was nominated to the deanery of Durham in 1646, but was prevented from being inſtalled by his death, which happened about two months after. He was a perſon learned and religious, exemplary in his converſation, courteous in his carriage, of a ſweet and obliging nature, and of a comely preſence. He was remarkable in his charity to the poor.

Potter (Dr John), archbiſhop of Canterbury, was the ſon of a linen-draper at Wakefield in Yorkſhire, where he was born about the year 1674. He ſtudied at Univerſity college, Oxford; and at 19 publiſhed *Variantes lectiones & notæ ad Plutarchi librum de audiendis poetis; & ad Baſilii magni orationem ad juvenes, quomodo cum fructu legere poſſint Græcorum libros*, 8vo, 1693. In 1697, came out his edition of *Lycophron*, in folio; which is reckoned the beſt of that obſcure writer: ſoon after, he publiſhed his *Antiquities of Greece*, 2 vols. 8vo. Theſe works eſtabliſhed his literary reputation, and engaged him in a correſpondence with Grævius and other learned foreigners. In 1706, he was made chaplain to the queen; in 1715, biſhop of Oxford; and in 1737, he ſucceeded archbiſhop Wake in the ſee of Canterbury; which high ſtation he ſupported with much dignity until his death in 1747. He was a learned and exemplary churchman; but not of an amiable diſpoſition, being but too ſtrongly tinctured with the pride of office; nor is it to his credit that he diſinherited his eldeſt ſon for marrying below his rank in life. His "Theological works, containing ſermons, charges, diſcourſes on church-government, and divinity lectures," were printed at Oxford, in 3 vols, 8vo, 1753.

POTTERY, the manufacture of earthen-ware, or the art of making earthen veſſels. See *Delft-Ware*, *Stone-Ware*, and Porcelain, &c.

The wheel and lathe are the chief and almoſt the only inſtruments in pottery: the firſt for large works, and the laſt for ſmall. The potter's wheel conſiſts principally in the nut, which is a beam or axis, whoſe foot or pivot plays perpendicularly on a free-ſtone ſole or bottom. From the four corners of this beam, which does not exceed two feet in height, ariſe four iron bars, called the *ſpokes of the wheel;* which forming diagonal lines with the beam, deſcend, and are faſtened at bottom to the edges of a ſtrong wooden circle, four feet in diameter, perfectly like the felloes of a coach-wheel, except that it has neither axis nor radii, and is only joined to the beam, which ſerves it as an axis by the iron-bars. The top of the nut is flat, of a circular

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* 151,875 l.

§ 632,812 l. 1 s.

† 506,249 l. 15 s. 6d.

‡ 253,124 l. 17s. 9d.

|| 56,861 l. 15s. 9d.

cular figure, and a foot in diameter; and on this is laid the clay which is to be turned and faſhioned. The wheel thus diſpoſed is encompaſſed with four ſides of four different pieces of wood faſtened on a wooden frame; the hind-piece, which is that on which the workman ſits, is made a little inclining towards the wheel; on the fore-piece are placed the prepared earth; on the ſide-pieces he reſts his feet, and theſe are made inclining to give him more or leſs room. Having prepared the earth, the potter lays a round piece of it on the circular head of the nut, and ſitting down turns the wheel with his feet till it has got the proper velocity; then, wetting his hands with water, he preſſes his fiſt or his finger-ends into the middle of the lump, and thus forms the cavity of the veſſel, continuing to widen it from the middle; and thus turning the inſide into form with one hand, while he proportions the outſide with the other, the wheel conſtantly turning all the while, and he wetting his hands from time to time. When the veſſel is too thick, he uſes a flat piece of iron, ſomewhat ſharp on the edge, to pare off what is redundant; and when it is finiſhed, it is taken off from the circular head by a wire paſſed under the veſſel.

The potter's lathe is alſo a kind of wheel, but more ſimple and ſlight than the former: its three chief members are an iron beam or axis three feet and a half high, and two feet and a half diameter, placed horizontally at the top of the beam, and ſerving to form the veſſel upon: and another large wooden wheel, all of a piece, three inches thick, and two or three feet broad, faſtened to the ſame beam at the bottom, and parallel to the horizon. The beam or axis turns by a pivot at the bottom in an iron ſtand. The workman gives the motion to the lathe with his feet, by puſhing the great wheel alternately with each foot, ſtill giving it a greater or leſſer degree of motion as his work requires. They work with the lathe with the ſame inſtruments, and after the ſame manner, as with the wheel. The mouldings are formed by holding a piece of wood or iron cut in the form of the moulding to the veſſel, while the wheel is turning round; but the feet and handles are made by themſelves and ſet on with the hand; and if there be any ſculpture in the work, it is uſually done in wooden moulds, and ſtuck on piece by piece on the outſide of the veſſel. For the glazing of the work, ſee GLAZING.

POTTLE, an Engliſh meaſure containing two quarts.

POVERTY ſignifies indigence or want of riches, and has been the lot of a large portion of men in every age. Whether, on the whole, it has been productive of good or bad conſequences, has been diſputed. In a moral view, perhaps it has been, on the whole, uſeful, as adverſity is in general more conducive to virtue than proſperity, which too often leads to luxury and vice.—Sometimes, however, poverty has had a baneful effect upon the mind, and has prompted men to commit very inhuman actions; but this in civilized communities very ſeldom occurs. In a political view, poverty is thought by ſome to be hurtful: Raynal thinks it is a check to population, (ſee his Hiſtory, vol vi. p. 471.); and Dr Smith ſo far agrees with him; for though he aſſerts, and indeed proves, that poverty is no check to the production of children, he allows it to be very unfavourable to raiſing them. See *Smith's Wealth of Nations*, vol. i. p. 119, &c. See alſo POOR.

POULADUFF, two remarkable great holes in the ground, about a mile weſt of Roſs, in the county of Cork, and province of Munſter, in Ireland, 80 yards deep, in which the ſea flows by ſubterraneous paſſages. They are called Eaſt and Weſt *Pouladuff*; one is on the lands of Downeen, and the other on Tralong.

POULTICE, a ſort of medicine, called alſo a *cataplaſm*. See CATAPLASMA.

POULTRY, all kind of domeſtic birds brought up in yards, as cocks, hens, capons, ducks, turkeys, &c.

Almoſt all the domeſtic birds of the poultry kind that we maintain in our yards are of foreign extraction: but there are others to be ranked in this claſs that are as yet in a ſtate of nature, and perhaps only wait till they become ſufficiently ſcarce to be taken under the care of man to multiply their propagation. It will appear remarkable enough, if we conſider how much the tame poultry which we have imported from diſtant climates has increaſed, and how much thoſe wild birds of the poultry kind that have never yet been taken into keeping have been diminiſhed and deſtroyed. They are all thinned; and many of the ſpecies, eſpecially in the more cultivated and populous parts of the country are utterly unſeen.

Under birds of the poultry kind may be ranked all thoſe that have white fleſh, and, comparatively to their heads and limbs, have bulky bodies. They are furniſhed with ſhort ſtrong bills for picking up grain, which is their chief and often their only ſuſtenance. Their wings are ſhort and concave; for which reaſon they are not able to fly far. They lay a great many eggs; and as they lead their young abroad, the very day they are hatched, in queſt of food, which they are ſhown by the mother, and which they pick up for themſelves, they generally make their neſts on the ground. The toes of all theſe are united by a membrane as far as the firſt articulation, and are then divided.

Under this claſs we may therefore render the common cock, the peacock, the turkey, the pintada or Guinea hen, the pheaſant, the buſtard, the grous, the partridge, and the quail. They all bear a ſtrong ſimilitude to each other, being equally granivorous, fleſhy, and delicate to the palate. They are among birds what beaſts of paſture are among quadrupeds, peaceable tenants of the field, and ſhunning the thicker parts of the foreſt, that abound with numerous animals who carry on unceaſing hoſtilities againſt them.

As nature has formed the rapacious claſs for war, ſo ſhe ſeems equally to have fitted theſe for peace, reſt, and ſociety. Their wings are but ſhort, ſo that they are ill formed for wandering from one region to another; their bills are alſo ſhort, and incapable of annoying their oppoſers: their legs are ſtrong indeed; but their toes are made for ſcratching up their food, and not for holding or tearing it. Theſe are ſufficient indications of their harmleſs nature; while their bodies, which are fat and fleſhy, render them unwieldy travellers, and incapable of ſtraying far from each other.

Accordingly, we find them chiefly in ſociety: they live together; and though they may have their diſputes, like all other animals, upon ſome occaſions; yet, when kept in the ſame diſtrict, or fed in the ſame yard, they learn the arts of ſubordination; and, in proportion as each knows his ſtrength, he ſeldom tries a ſecond time the combat where he has once been worſted.

In this manner, all of this kind ſeem to lead an indolent voluptuous life. As they are furniſhed internally with a very ſtrong ſtomach, commonly called a *gizzard*, ſo their voraciouſneſs ſcarce knows any bounds. If kept in cloſe captivity, and ſeparated from all their former companions, they have ſtill the pleaſure of eating left; and they ſoon grow fat and unwieldy in their priſon. To ſay this more ſimply, many of the wilder ſpecies of birds, when cooped or caged, pine away, grow gloomy, and ſome refuſe all ſuſtenance whatever; none except thoſe of the poultry kind grow fat, who ſeem to loſe all remembrance of their former liberty, ſatisfied with indolence and plenty.

POUNCE, gum ſandarach pounded and ſifted very fine, to rub on paper in order to preſerve it from drinking, and to make it more fit to write upon.

Pounce, is alſo a little heap of charcoal duſt, incloſed in a piece of muſlin or ſome other open ſtuff, to be paſſed over holes pricked in a work, in order to mark the lines or deſigns thereof on paper, ſilk, &c. placed underneath; which are to be afterwards finiſhed with a pen and ink, a needle, or the like. This kind of pounce is much uſed by embroiderers, to transfer their patterns upon ſtuffs; by lace-makers, and ſometimes alſo by engravers.

Pounces, in falconry, the talons or claws of a bird of prey.

POUND, a ſtandard-weight; for the proportion and ſubdiviſions of which, ſee the article Weight.

Pound alſo denotes a money of account; ſo called, becauſe that ancient pound of ſilver weighed a pound one penny troy.

Pound, among lawyers, denotes a place of ſtrength, in which to keep cattle that are diſtrained, or put in for treſpaſs, until they are replevied or redeemed.

POUNDAGE, in England a ſubſidy of 12d. in the pound, granted to the crown on all goods and merchandizes exported or imported; and if by aliens, more.

POURPRESTURE, in law, is a wrongful incloſure, or incroachment upon another perſon's property.

POURSUIVANT, or Pursuivant, in heraldry, the loweſt order of officers at arms.—They are properly attendants on the heralds when they marſhal public ceremonies. Of theſe in England there were formerly many; but at preſent there are only four, viz. blue-mantle, rouge-croſs, rouge-dragon, and port cullice. In Scotland there is only one king at arms, who is ſtyled *Lyon*; and has under him no leſs than ſix heralds, as many purſuivants, and a great many meſſengers at arms. See Lyon.

POURVEYANCE, or Purveyance, in Engliſh law, the providing corn, fuel, victuals, &c. for the king's houſehold; and hence the officer who did ſo was termed *pourveyor*. As ſeveral offences were committed by theſe officers, it was enacted by ſtat. 12. Car. II. that no perſon, under colour of pourveyance, ſhall take any timber, cattle, corn, &c. from any ſubject without his free conſent, or without a juſt appraiſement and paying for the ſame.

POUSSIN (Nicholas), an eminent French painter, born in 1594, at Andel, a little city in Normandy, where his father was of noble extraction, but born to a ſmall eſtate. He was inſtructed for a few months by one Ferdinand Elle, a portrait-painter, and afterwards ſpent a month with L'Allemant; but finding theſe artiſts not likely to improve him ſuitably to his deſires, he firſt ſtudied the paintings of the beſt maſters, and then haſtened to finiſh a few pieces he was engaged in, and travelled to Italy. Here he devoted almoſt his whole attention to the ſtudy of antique ſtatutes and bas reliefs; which was probably the cauſe of his want of knowledge in, and taſte for, the art of colouring. Being invited back to Paris by Louis XIII. who aſſigned him a penſion with lodgings in the Thuilleries, he painted for prince Juſtiniani an hiſtorical picture repreſenting Herod's cruelty; an admirable compoſition, in which he gave ſuch expreſſion to every character, as could not fail to ſtrike the beholder with terror and pity: he then laboured for ſeveral years on the celebrated pictures of the ſeven ſacraments of the Romiſh church. But none of Pouſſin's deſigns have been more generally admired than that of the death of Germanicus; which would have gained him immortal honour if he had never painted another picture. He began the labours of Hercules in the gallery of the Louvre; but the faction of Vouet's ſchool railing at him and his performances, put him ſo out of humour with his own country, that he returned to Rome, where he died in 1665. He never went beyond eaſel-pieces, for which he had a perpetual demand; and his method was to fix the price he expected on the back of the canvas, which was readily paid.

Poussin (Gaſpar). This painter, whoſe real name was *Dughet*, was born at Paris in 1600; and was induced to travel to Rome, not only from a love to the art of painting, but alſo to viſit his ſiſter, who was married to Nicholas Pouſſin. Sandrart ſays that Gaſpar was employed at firſt only to prepare the pallet, pencils, and colours, for Nicholas; but by the precepts and example of that excellent maſter, gradually roſe to the higheſt reputation, and is undoubtedly one of the beſt landſcape painters that ever appeared. It is generally thought that no painter ever ſtudied nature to better purpoſe, or repreſented the effects of land-ſtorms more happily, than Gaſpar; all his trees ſhow a natural degree of agitation, every leaf being in motion; his ſcenes are all beautifully choſen, as are the ſites of his buildings. He deſigned human figures but very indifferently; for which reaſon he frequently prevailed on Nicholas to paint them for him; and they were always introduced with the utmoſt propriety. While he continued at Rome he dropped his own name, and aſſumed that of his brother-in-law and benefactor, by which only he is at preſent known. He died in 1662.

POWDER, in pharmacy, a dry medicine well broken, either in a mortar by grinding or by ſome chemical operation.

Gun-Powder. See Gunpowder. See alſo Obſervations on Gunpowder in the Iriſh Tranſactions 1788, p. 97. claſs *Science*, by Mr Napier.

Powder-Cheſts, certain ſmall boxes charged with powder and a quantity of old nails or ſplinters of iron, and faſtened occaſionally on the deck and ſides of a ſhip, in order to be diſcharged on an enemy who attempts to ſeize her by boarding. Theſe caſes are uſually from 12 to 18 inches in length, and about eight or ten in breadth, having their outer or upper part terminating in an edge. They are nailed to ſeveral places of the quarter-deck and bulk-head of the waiſt, having a train of powder, which communicates with the inner apartments of the ſhip, ſo as to be fired at pleaſure to annoy the enemy. They are particularly uſed in merchant-ſhips which are furniſhed with cloſe-quarters to oppoſe the boarders.

Powder Magazine, a bomb-proof arched building, to contain powder in fortified places.

Powder for the Hair. The beſt ſort is ſtarch well pounded and ſifted, and generally prepared with ſome perfume.

James's Powder. See *James's Powder*. In the Philoſophical Tranſactions for 1791, p. 317. there is a paper by Dr Pearſon, containing experiments and obſervations on James's powder. Dr Pearſon ſays, it was originally a patent medicine; but it is well known that it cannot be prepared by following the directions of the ſpecification in the court of chancery. His obſervations and experiments, therefore, he thinks, may explain the nature and manner of preparing this medicine, and perhaps may extend the hiſtory of antimony. The reſult of the whole, in Dr Pearſon's own words, is as follows:

1. James's powder conſiſts of phoſphoric acid, lime, and antimonial calx; with a minute quantity of calx of iron, which is conſidered to be an accidental ſubſtance. 2. Either theſe three eſſential ingredients are united with each other, forming a triple compound, or phoſphorated lime is combined with the antimonial calx, compoſing a double compound in the proportion of about 57 parts of calx and 43 parts of phoſphorated lime. 3. This antimonial calx is different from any other known calx of antimony in ſeveral of its chemical qualities. About three-fourths of it are ſoluble in marine acid, and afford Algaroth powder; and the remainder is not ſoluble in this menſtrum, and is apparently vitrified. It alſo appears, that by calcining together bone-aſhes, that is, phoſphorated lime and antimony in a certain proportion, and afterwards expoſing the mixture to a white heat, a compound was formed, conſiſting of antimonial calx and phoſphorated lime in the ſame proportion, and poſſeſſing the ſame kind of chemical properties as James's powder.

POWDIKE, in the fens of Norfolk and Ely. By ſtat. 22 Hen. VIII. c. 11. perverſely to cut down and deſtroy the powdike in the fens of Norfolk and Ely is felony. See *Blackſtone's Commentaries* vol. iv. p. 243.

POWER, has been defined the faculty of doing or ſuffering any thing. Power, therefore, is two-fold, viz. conſidered as able to make, or able to receive, any change; the former whereof may be called *active*, and the latter *paſſive, power*: but this diſtinction is improper. See Metaphysics, n° 116.

Power, in mechanics, denotes any force, whether of a man a horſe, a ſpring, the wind, water &c. which being applied to a machine, tends to produce motion.

Power, in law, ſignifies in general a particular authority granted by any perſon to another to repreſent him, or to act in his ſtead.

POWERS in arithmetic and algebra, are nothing but the products ariſing from the continual multiplications of a number or quantity into itſelf. See Algebra and Arithmetic.

POX, *French-Pox*, or *Lues Venerea*. See Medicine, n° 350

Small-Pox See Inoculation, and Medicine, n° 222—226.

POYNING's law, an act of parliament made in Ireland under Henry VII. whereby all the ſtatues of force in England were made of force in Ireland; which before that time they were not.—Nor are any now in force there made in England ſince that time.

The law took its name from Sir Edward Poyning, lord-lieutenant of that kingdom at the time of its making. See Ireland, n° 46.

POZZOLANA, See Puzzolana.

PRACTICE, in arithmetic. See there, n° 16. &c.

Gun-Practice, in Engliſh military education. In the ſpring, as ſoon as the weather permits, the exerciſe of the great guns begins, with an intention to ſhow the gentlemen cadets at the royal military academy at Woolwich, and private men, the manner of laying, loading, pointing, and firing the guns. Sometimes inſtruments are uſed to find the centre line, or two points, one at the breech, the other at the muzzle, which are marked with chalk, and whereby the piece is directed to the target: then a quadrant is put into the mouth to give the gun the required elevation, which at firſt is gueſſed at, according to the diſtance the target is from the piece. When the piece has been fired, it is ſponged to clear it from any duſt or ſparks of fire that might remain in the bore, and loaded: then the centre line is found as before; and if the ſhot went too high or too low, to the right or to the left, the elevation and trail are altered accordingly, This practice continues morning and evening for about ſix weeks, more or leſs according as there are a greater or leſs number of recruits. In the mean time others are ſhown the motions of quick-firing with field-pieces.

Mortar-Practice, generally thus. A line of 1500, or 2000 yards is meaſured in an open ſpot of ground from the place where the mortars ſtand, and a flag fixed at about 300 or 500 yards: this being done, the ground where the mortars are to be placed is prepared and levelled with ſand, ſo that they may lie at an elevation of 45 degrees; then they are loaded with a ſmall quantity of powder at firſt, which is increaſed afterwards by an ounce every time, till they are loaded with a full charge; the times of the flights of the ſhells are obſerved, to determine the length of the fuzes. The intention of this practice is, when a mortar battery is raiſed in a ſiege, to know what quantity of powder is required to throw the ſhells into the works at a given diſtance, and to cut the fuzes of a juſt length, that the ſhell may burſt as ſoon as it touches the ground.

PRÆMUNIRE, in Engliſh law, is taken either for a writ ſo called, or for the offence whereon the writ is granted; the one may be underſtood by the other.—The church of Rome, under pretence of her ſupremacy and the dignity of St Peter's chair, took on her to beſtow moſt of the eccleſiaſtical livings of any worth in England, by mandates, before they were void; pretending therein great care to ſee the church provided of a ſucceſſor before it needed. Whence theſe mandates or bulls were called *gratiæ expectativæ, or proviſiones*; whereof ſee a learned diſcourſe in *Duarenus de beneficiis*, Blackſt. Comment.

beneficiis, lib. 3. cap. 1. Theſe proviſions were ſo common, that at laſt Edward I. not digeſting ſo intolerable an encroachment, in the 35th year of his reign made a ſtatute againſt papal proviſions, which, according to Sir Edward Coke, is the foundation of all the ſubſequent ſtatutes of præmunire: which is ranked as an offence immediately againſt the king, becauſe every encouragement of the papal power is a diminution of the authority of the crown.

In the weak reign of Edward II. the pope again endeavoured to encroach, but the parliament manfully withſtood him; and it was one of the articles charged againſt that unhappy prince, that he had given allowance to the bulls of the ſee of Rome. But Edw. III. was of a temper extremely different; and, to remedy theſe inconveniences, firſt by gentle means, he and his nobility wrote an expoſtulation to the pope: but receiving a menacing and contemptuous anſwer, withal acquainting him, that the emperor (who a few years before at the diet of Nuremberg, A. D. 1323, had eſtabliſhed a law againſt proviſions), and alſo the king of France, had lately ſubmitted to the holy ſee; the king replied, that if both the emperor and the French king ſhould take the pope's part, he was ready to give battle to them both, in defence of the liberties of the crown. Hereupon more ſharp and penal laws were deviſed againſt proviſors, which enact ſeverally, that the court of Rome ſhall preſent or collate to no biſhopric or living in England; and that whoever diſturbs any patron in the preſentation to a living by virtue of a papal proviſion, ſuch proviſor ſhall pay fine and ranſom to the king at his will, and be impriſoned till he renounces ſuch proviſion; and the ſame puniſhment is inflicted on ſuch as cite the king, or any of his ſubjects, to anſwer in the court of Rome. And when the holy ſee reſented theſe proceedings, and pope Urban V. attempted to revive the vaſſalage and annualrent to which king John had ſubjected his kingdom, it was unanimouſly agreed by all the eſtates of the realm in parliament aſſembled, 40 Edw. III. that king John's donation was null and void, being without the concurrence of parliament, and contrary to his coronation-oath; and all the temporary nobility and commons engaged, that if the pope ſhould endeavour by proceſs or otherwiſe to maintain theſe uſurpations, they would reſiſt and withſtand him with all their power.

In the reign of Richard II. it was found neceſſary to ſharpen and ſtrengthen theſe laws, and therefore it was enacted by ſtatutes 3 Ric. II. c. 3. and 7. Ric. II. c. 12. firſt, that no alien ſhall be capable of letting his benefice to farm; in order to compel ſuch as had crept in, at leaſt to reſide on their preferments: and afterwards, that no alien ſhould be capable to be preſented to any eccleſiaſtical preferment, under the penalty of the ſtatutes of proviſors. By the ſtatute 12 Rich. II. c. 15. all liegemen of the king accepting of a living by any foreign proviſion, are put out of the king's protection, and the benefice made void. To which the ſtatute 13 Rich. II. ſt. 2. c. 2. adds baniſhment and forfeiture of land and goods: and by c. 3. of the ſame ſtatute, any perſon bringing over any citation or excommunication from beyond ſea, on account of the execution of the foregoing ſtatutes of proviſors, ſhall be impriſoned; forfeit his goods and lands, and moreover ſuffer pain of life and member.

In the writ for the execution of all theſe ſtatutes, the words *præmunire facias* being uſed to command a citation of the party, have denominated in common ſpeech, not only the writ, but the offence itſelf of maintaining the papal power, by the name of *præmunire*. And, accordingly, the next ſtatute we ſhall mention, which is generally referred to by all ſubſequent ſtatutes, is uſually called the *ſtatute of præmunire*. It is the ſtatute 16 Richard II. c. 5. which enacts, that whoever procures at Rome, or elſewhere, any tranſlations, proceſſes, excommunications, bulls, inſtruments, or other things which touch the king, againſt him, his crown, and realm, and all perſons aiding and aſſiſting therein, ſhall be put out of the king's protection, their lands and goods forfeited to the king's uſe, and they ſhall be attached by their bodies to anſwer to the king and his council; or proceſs of *præmunire facias* ſhall be made out againſt them as in other caſes of proviſors.

By the ſtatute 2 Henry IV. c. 3. all perſons who accept any proviſion from the pope, to be exempt from canonical obedience to their proper ordinary, are alſo ſubjected to the penalties of præmunire. And this is the laſt of the ancient ſtatutes touching this offence: the uſurped civil power of the biſhop of Rome being pretty well broken down by theſe ſtatutes, as his uſurped religious power was in about a century afterwards: the ſpirit of the nation being ſo much raiſed againſt foreigners, that about this time, in the reign of Hen. V. the alien priories, or abbeys for foreign monks, were ſuppreſſed, and their lands given to the crown. And no farther attempts were afterwards made in ſupport of theſe foreign juriſdictions.

This, then, is the original meaning of the offence which we call *præmunire*; viz. introducing a foreign power into the land, and creating *imperium in imperio*, by paying that obedience to papal proceſs which conſtitutionally belonged to the king alone, long before the Reformation in the reign of Henry VIII. at which time the penalties of præmunire were indeed extended to more papal abuſes than before; as the kingdom then entirely renounced the authority of the ſee of Rome, though not at all the corrupted doctrines of the Roman church. And therefore, by the ſeveral ſtatutes of 24 Hen. VIII. c. 12. and 25 Hen. VIII. c. 19. & 21. to appeal to Rome from any of the king's courts, which (though illegal before) had at times been connived at; to ſue to Rome for any licence or diſpenſation, or to obey any proceſs from thence, are made liable to the pains of præmunire. And, in order to reſtore to the king in effect the nomination of vacant biſhoprics, and yet keep up the eſtabliſhed forms, it is enacted by ſtatute 25 Hen. VIII. c. 20. that if the dean and chapter refuſe to elect the perſon named by the king, or any archbiſhop or biſhop to confirm or conſecrate him, they ſhall fall within the penalties of the ſtatutes of præmunire. Alſo by ſtatute 5 Eliz. c. 1. to refuſe the oath of ſupremacy will incur the pains of præmunire; and to defend the pope's juriſdiction in Britain, is a præmunire for the firſt offence, and high treaſon for the ſecond. So, too, by ſtatute 13 Eliz. c. 2. to import any *agnus Dei*, croſſes, beads, or other ſuperſtitious things pretended to be hallowed by the biſhop of Rome, and tender the ſame to be uſed; or to receive the ſame with ſuch intent, and not diſcover the offender; or if a juſtice of the peace, knowing thereof, ſhall not within

14 days declare it to a privy-counſellor, they all incur a præmunire. But importing or ſelling maſs-books, or other Popiſh books, is by ſtat. 3. Jac. I. c. 5. § 25. only liable to a penalty of 40 s. Laſtly, to contribute to the maintenance of a Jeſuit's college, or any Popiſh ſeminary whatever beyond ſea, or any perſon in the ſame, or to contribute to the maintenance of any Jeſuit or Popiſh prieſt in England, is by ſtatute 27 Eliz. c. 2. made liable to the penalties of præmunire.

Thus far the penalties of præmunire ſeem to have kept within the proper bounds of their original inſtitution, the depreſſing the power of the pope: but they being pains of no conſiderable conſequence, it has been thought fit to apply the ſame to other heinous offences; ſome of which bear more, and ſome leſs, relation to this original offence, and ſome no relation at all.

Thus, 1. By the ſtatute 1 & 2 Ph. and Mar. c. 8. to moleſt the poſſeſſors of abbey-lands granted by parliament to Henry VIII. and Edward VI. is a præmunire. 2. So likewiſe is the offence of acting as a broker or agent in any uſurious contract where above 10 *per cent.* intereſt is taken, by ſtatute 13 Eliz. c. 10. 3. To obtain any ſtay of proceedings, other than by arreſt of judgment or writ of error, in any ſuit for a monopoly, is likewiſe a præmunire, by ſtat. 21. Jac. I. c. 3. 4. To obtain an excluſive patent for the ſole making or importation of gunpowder or arms, or to hinder others from importing them, is alſo a præmunire by two ſtatutes; the one 16 Car. I. c. 21. the other 1 Jac. II. c. 8. 5. On the abolition, by ſtat. 12. Car. II. c. 24. of purveyance, and the prerogative of pre-emption, or taking any victual, beaſt, or goods for the king's uſe, at a ſtated price, without conſent of the proprietor, the exertion of any ſuch power for the future was declared to incur the penalties of præmunire. 6. To aſſert, maliciouſly and adviſedly, by ſpeaking or writing, that both or either houſe of parliament have a legiſlative authority without the king, is declared a præmunire by ſtatute 13 Car. II. c. 1. 7. By the *habeas corpus* act alſo, 31 Car. II. c. 2. it is a præmunire, and incapable of the king's pardon, beſides other heavy penalties, to ſend any ſubject of the realm a priſoner into parts beyond the ſeas. 8. By the ſtatute 1 W. & M. ſt. 1. c. 8. perſons of 18 years of age refuſing to take the new oaths of allegiance as well as ſupremacy, upon tender by the proper magiſtrate, are ſubject to the penalties of a præmunire; and by ſtatutes 7 & 8 W. III. c. 24. ſerjeants, counſellors, proctors, attorneys, and all officers of courts, practiſing without having taken the oaths of allegiance and ſupremacy, and ſubſcribed the declaration againſt popery, are guilty of a præmunire whether the oaths be tendered or not. 9. By the ſtatute 6 Ann. c. 7. to aſſert maliciouſly and directly, by preaching, teaching, or adviſed ſpeaking, that the then pretended prince of Wales, or any perſon other than according to the acts of ſettlement and union, hath any right to the throne of theſe kingdoms, or that the king and parliament cannot make laws to limit the deſcent of the crown; ſuch preaching, teaching, or adviſed ſpeaking, is a præmunire: as writing, printing, or publiſhing the ſame doctrines amounted, we may remember, to high treaſon. 10. By ſtatute 6 Ann. c 23. if the aſſembly of peers of Scotland, convened to elect their 16 repreſentatives in the Britiſh parliament, ſhall preſume to treat of any other matter ſave only the election, they incur the penalties of a præmunire. 11. The ſtat. 6 Geo. I. c. 18. (enacted in the year after the infamous South Sea project had beggared half the nation) makes all unwarrantable undertakings by unlawful ſubſcriptions, then commonly known by the name of *bubbles*, ſubject to the penalties of a præmunire. 12. The ſtat. 12. Geo. III. c. 11. ſubjects to the penalties of the ſtatute of præmunire all ſuch as knowingly and wilfully ſolemnize, aſſiſt, or are preſent at, any forbidden marriage of ſuch of the deſcendants of the body of king Geo. II. as are by that act prohibited to contract matrimony without the conſent of the crown.

Having thus enquired into the nature and ſeveral ſpecies of præmunire, its puniſhment may be gathered from the foregoing ſtatutes, which are thus ſhortly ſummed up by Sir Edward Coke: "That, from the conviction, the defendant ſhall be out of the king's protection, and his lands and tenements, goods and chattels, forfeited to the king; and that his body ſhall remain in priſon at the king's pleaſure, or (as other authorities have it) during life; both which amount to the ſame thing, as the king by his prerogative may at any time remit the whole, or any part of the puniſhment, except in the caſe of tranſgreſſing the ſtatute of *habeas corpus*. Theſe forfeitures here inflicted do not (by the way) bring this offence within our former definition of FELONY; being inflicted by particular ſtatutes, and not by the common law." But ſo odious, Sir Edward Coke adds, was this offence of præmunire, that a man that was attainted of the ſame, might have been ſlain by any other man without danger of law; becauſe it was provided by law, that any man might do to him as to the king's enemy; and any man may lawfully kill an enemy. However, the poſition itſelf, that it is at any time lawful to kill an enemy, is by no means tenable: it is only lawful, by the law of nature and nations, to kill him in the heat of battle, or for neceſſary ſelf-defence. And to obviate ſuch ſavage and miſtaken notions, the ſtatute 5 Eliz. c. 1. provides, that it ſhall not be lawful to kill any perſon attainted in a præmunire, any law, ſtatute, opinion, or expoſition of law to the contrary notwithſtanding. But ſtill ſuch delinquent, though protected as a part of the public from public wrongs, can bring no action for any private injury, how atrocious ſoever; being ſo far out of the protection of the law, that it will not guard his civil rights, nor remedy any grievance which he as an individual may ſuffer. And no man, knowing him to be guilty, can with ſafety give him comfort, aid, or relief.

PRÆNESTE (anc. geog.), a town of Latium, to the ſouth-eaſt of Rome, towards the territory of the Æqui; a place of great ſtrength. Famous for the temple and oracle of Fortune, called *Sortes Præneſtinæ* (Strabo); which Tiberius wanted to deſtroy, but was deterred by the awful majeſty of the place. From a colony it was raiſed to a municipium by Tiberius (Inſcriptions, Florus, A. Gellius), on the conſideration of his recovery from a dangerous illneſs near this place. Thither the Roman emperors uſually retired, on account of the agreeableneſs of the ſituation (Suetonius). It was a very ancient city, with a territory of large extent (Livy). The temple of Fortune was built in the moſt ſumptuous manner by Sylla, and the pavement was Moſaic work (Pliny). Concerning the Sortes, there is a remarkable paſſage in Cicero; who ſays, that it was all a mere contrivance, in order to deceive, either for the purpoſes of gain or ſuperſtition. The town that has ſucceeded it ſtands low in a valley, and is called *Paleſtrina*, in the Campania of Rome. E. Long. 13. 30. N. Lat. 42. 0.

PRÆSIDIUM (Notitia), a town of the Cornavii in Britain. Now thought to be Warwick (Camden).—Another of Corſica (Antonine), 30 miles to the ſouth of Aleria.—A third *Præſidium* ſurnamed *Julium*, in Bætica (Pliny).

PRÆTORIA AUGUSTA (Ptolemy), a town of Dacia. Now called *Braſſow* by the natives, and *Cronſtadt* by the Germans (Baudrand): a town in Tranſylvania. E. Long. 25°. N. Lat. 47°.—Another of the Salaſſii, near the two gates or defiles of the Alps, the Grajæ and Pinninæ (Pliny); a Roman colony, ſettled by Auguſtus after the defeat of the Salaſſii by Terentius Varro, on the ſpot where he encamped (Strabo, Dio Caſſius, Ptolemy), ſituated on the river Duria Major. The town is now called *Aoſta* or *Aouſt*, in Piedmont. E. Long. 7. 14. N. Lat. 45. 19.

PRÆTORIUM (Antonine, Notitia Imperii), a town of the Brigantes. Now *Paterington* (Camden), near the mouth of the Humber in Yorkſhire. *Coventry* (Talbot).

PRAGMATIC SANCTION, in the civil law, is defined by Hottoman to be a reſcript or anſwer of the ſovereign, delivered by advice of his council, to ſome college, order, or body of people, upon conſulting him on ſome caſe of their community. The like anſwer given to any particular perſon is called ſimply *reſcript*.

The term *pragmatic ſanction* is chiefly applied to a ſettlement of Charles VI. emperor of Germany, who, in the year 1722, having no ſons, ſettled his hereditary dominions on his eldeſt daughter the archducheſs Maria Thereſa, which was confirmed by the diet of the empire, and guaranteed by Great Britain, France, the States-General, and moſt of the powers in Europe. The word *pragmatic* is derived from the Greek πραγμα, *negotium*, "buſineſs."—It is ſometimes alſo called abſolutely *pragmatic*, το πραγματικον.

PRAGUE, a city of Bohemia, and capital of the whole kingdom, is ſituated 14° 40′ of longitude, and 50° 5′ of latitude. It ſtands on both ſides the Moldau, over which there is a bridge 700 feet long, built of large freeſtone. The river, though of great breadth here, is nevertheleſs ſhallow, and not navigable. On both ſides the bridge are ſeveral ſtatues, and among others that of St John of Nepomuch, whom king Wenſel cauſed to be thrown from the bridge into the river, for venturing to reprove him upon ſome occaſion; but in 1720 he was canonized as a ſaint, and is at preſent held in ſuch veneration in Bohemia, that all other ſaints ſeem on his account to be forgotten. Near the bridge, which ſtands at the upper part of the city, the number of people is very great, but the further you go from thence the more deſolate you find every place. The city is about three miles long and two broad; the number of its Chriſtian inhabitants is ſaid to be 70,000, and of Jews about 12,000. The principal branch of its trade conſiſts in brewing of beer. It is divided into the Old and the New Towns, and that called the *Small ſide*; the former lying on the eaſt ſide of the Moldau, and the latter on the weſt. The whole is about 12 miles in circumference. The fortifications are not of great importance, as it may be flanked and raked on all ſides. However, the king of Pruſſia was not able to make himſelf maſter of it in the late war, though he almoſt deſtroyed it with his bombs, &c. See PRUSSIA, n° 24, &c.—It hath ſuffered greatly by ſieges, and hath been often taken and plundered. The univerſity was founded by Charles IV. in the year 1347. In 1409, when John Huſs was rector of the univerſity, there were no leſs than 44,000 ſtudents; and when the emperor Charles V. would have retrenched their privileges, 24,000 are ſaid to have left it in one week, and 16,000 in a ſhort time after. The Jews have the trade of this city almoſt entirely in their own hands. They deal in all ſorts of commodities, eſpecially the precious ſtones found in the Bohemian mines, and, by receiving all old-faſhioned things in payment, quite ruin the Chriſtian handicraftſmen. In 1744 they narrowly eſcaped being expelled the kingdom, having been ſuſpected of correſponding with the Pruſſians, when they made themſelves maſters of the city. The grand prior of the order of Malta, for Bohemia, Moravia, and Sileſia, reſides here; and the church and hoſpital of the Holy Ghoſt is the ſeat of the general and grandmaſters of the holy order of knights of the croſs with the red ſtar, reſiding in the abovementioned countries, and in Poland and Hungary. The houſes of this city are all built of ſtone, and generally conſiſt of three ſtories; but there are very few good buildings in it, and almoſt every thing looks dirty. The cathedral, which is dedicated to St Veit, is an old building, in which there are ſome pieces of excellent architecture and many magnificent tombs of great men. There are 100 churches and chapels, and about 40 cloiſters in the place. On Ratſchin-hill, in Upper Prague, moſt of the nobility have houſes, and the emperor a very magnificent palace, and a ſummer-houſe commanding one of the fineſt proſpects in the world. Here the tribunals of the regency meet; and the halls, galleries, and other apartments, are adorned with a multitude of noble pictures. The great hall, where the coronation feaſt is kept, is ſaid to be the largeſt of the kind in Europe next to that of Weſtminſter. The caſtle ſtands on the abovementioned mountain, called *Ratſchin* or the *White Mountain*, and is very ſtrong. From a window of this caſtle the emperor's counſellors were thrown in 1618; but though they fell from a great height, yet they were not killed, nor indeed much hurt. On the ſame mountain ſtands alſo the archiepiſcopal palace. In the New Town is an arſenal, and a religious foundation for ladies, called the *Free Temporal Engliſh Foundation*, over which an abbeſs preſides. In the Leſſer Side or Town, the counts Colloredo and Wallenſtein have very magnificent palaces and gardens. The ſtables of the latter are very grand; the racks being of ſteel and the mangers of marble, and a marble pillar betwixt each horſe; over each horſe alſo is placed his picture as big as life. Though the inhabitants of Prague in general are poor, and their ſhops but meanly furniſhed, yet, it is ſaid, there are few cities where the nobility and gentry are more wealthy, and live in greater ſtate. Here is much gaming, maſquerading, feaſting, and very ſplendid public balls, with an Italian opera, and aſſemblies in the houſes of the quality every night. On the White Mountain, near the town, was fought the battle in which the Proteſtants, with the elector Palatine Frederic their king, were defeated.

The luſtres and drinking-glaſſes made here of Bohemian cryſtal are much eſteemed, and vended all over Europe. Theſe cryſtals are alſo poliſhed by the Jews, and ſet in rings, ear-pendants, and ſhirt-buttons. The chief tribunal conſiſts of twelve ſtadtholders, at the head of whom is the great burgrave, governor of the kingdom and city, immediately under the emperor, and the chancery of Bohemia. Though the city of Prague is very ill-built, it is pleaſantly ſituated, and ſome of the proſpects are beautiful, and the gardens and pleaſure-houſes are excellent. The people, Rieſbeck informs us, enjoy ſenſual pleaſures more than thoſe of Vienna, becauſe they know better how to connect mental enjoyments with them. The numerous garriſon kept in the place (9000 men) contributes much to its gaiety and livelineſs.

PRAM, or PRAME, a kind of lighter uſed in Holland and the ports of the Baltic Sea, to carry the cargo of a merchant-ſhip *along-ſide*, in order to lade or to bring it to ſhore to be lodged in the ſtorehouſes after being diſcharged out of the veſſel.

PRAME, in military affairs, a kind of floating battery, being a flat-bottomed veſſel, which draws little water, mounts ſeveral guns, and is very uſeful in covering the diſembarkation of troops. They are generally made uſe of in tranſporting troops over the lakes in America.

PRAMNION, in natural hiſtory, the name of a ſemipellucid gem. This is a very ſingular ſtone, and of a very great concealed beauty. The lapidaries, when they meet with it, call it by the name of the *black agate*. It is of an extremely cloſe, compact, and firm texture, of a ſmooth and equal ſurface, and in ſhape very irregular, being ſometimes round, ſometimes oblong, and often flat; in ſize it ſeldom exceeds two inches. It appears, on a common inſpection, to be of a fine deep black; but held up againſt the ſun or the light of a candle, it is an elegant red, clouded by a quantity of ſubtile black earth. It is brought from the Eaſt Indies.

PRASIUM, in botany: A genus of the gymnoſpermia order, belonging to the didynamia claſs of plants; and in the natural method ranking under the 42d order, *Verticillatæ*. There are four monoſpermous berries.

PRATINAS, a Greek poet contemporary with Æſchylus, born at Phlius. He was the firſt among the Greeks who compoſed ſatires, which were repreſented as farces. Of theſe 32 were acted, as alſo 18 of his tragedies, one of which only obtained the poetical prize. Some of his verſes are extant, quoted by Athenæus.

PRATIQUE, or PRATTIC, in commerce, a negociation or communication of commerce which a merchant-veſſel obtains in the port it arrives in and the countries it diſcovers: hence to obtain a pratique, is to obtain liberty to frequent a port, to go aſhore, to buy and ſell, &c.

PRATT (Charles), earl of Camden, was the third ſon of Sir John Pratt, knight, chief-juſtice of the court of king's-bench under George I. by his ſecond wife Elizabeth, daughter of the Reverend Hugh Wilſon canon of Bangor and was born in 1713, the year before his father was called to the honour of the bench. He received the firſt rudiments of his education at Eton, and afterwards removed to king's college Cambridge. Of his early life at both places there is little known, other than that at college he was found to be remarkably diligent and ſtudious, and particularly ſo in the hiſtory and conſtitution of his country. By ſome he was thought to be a little too tenacious of the rights and privileges of the college he belonged to: but perhaps it was to this early tendency that we are indebted for thoſe noble ſtruggles in defence of liberty, which, whether in or out of office, he diſplayed through the whole courſe of his political life. After ſtaying out the uſual time at college, and taking his maſter's degree, in 1739 he entered himſelf a ſtudent of the Inner Temple, and was in due time admitted by that honourable ſociety as a barriſter at law. And here a circumſtance developes itſelf in the hiſtory of this great man, which ſhows how much chance governs in the affairs of this world, and that the moſt conſiderable talents and indiſputable integrity will ſometimes require the introduction of this miſtreſs of the ceremonies, in order to obtain that which they ought to poſſeſs from their own intrinſic qualifications.

Mr Pratt, after his being called to the bar, notwithſtanding his family introduction, and his own perſonal character, was very near nine years in the profeſſion, without ever getting in any degree forward. Whether this aroſe from a natural timidity of conſtitution, ill-luck, or perhaps a mixture of deſpondence growing out of the two circumſtances, it is now difficult to tell; but the fact was ſo: and he was ſo diſpirited by it, that he had ſome thoughts of relinquiſhing the profeſſion of the law, and retiring to his college, where, in rotation, he might be ſure of a church living, that would give him a ſmall but honourable independence. With theſe melancholy ideas he went as uſual the weſtern circuit, to make one more experiment, and then to take his final determination. Mr Henly, afterwards Lord Northington and chancellor of England, was in the ſame circuit: he was Mr Pratt's moſt intimate friend; and he now availed himſelf of that friendſhip, and told him his ſituation, and his intentions of retiring to the univerſity and going into the church. He oppoſed his intention with ſtrong raillery, and got him engaged in a cauſe along with himſelf; and Mr Henley being ill, Mr Pratt took the lead, and diſplayed a profeſſional knowledge and elocution that excited the admiration of his brother barriſters as much as that of the whole court. He gained his cauſe; and beſides, he acquired the reputation of an eloquent, profound, and conſtitutional lawyer. It was this circumſtance, together with the continued good offices of his friend Henley, which led to his future greatneſs; for with all his abilities and all his knowledge, he might otherwiſe in all probability have paſſed his life in obſcurity unnoticed and unknown.

He became now one of the moſt ſucceſsful pleaders at the bar, and honours and emoluments flowed thick upon him. He was choſen to repreſent the borough of Downton, Wilts, after the general election in 1759; recorder of Bath 1759; and the ſame year was appointed attorney-general; in January 1762 he was called to the degree of ſerjeant at law, appointed chief-juſtice of the common pleas, and knighted. His lordſhip preſided in that court with a dignity, weight and impartiality, never exceeded by any of his predeceſſors; and when John Wilkes, Eſq; was ſeized and committed to the Tower on an illegal general warrant, his Lordſhip with the intrepidity of a Britiſh magiſtrate, and the becoming fortitude of an Engliſhman, granted him an *habeas corpus;* and on his being brought before the court of common pleas, diſcharged him from his confinement in the Tower, May 6. 1763, in a ſpeech which did him honour. His wiſe and ſpirited behaviour on this remarkable occaſion, ſo intereſting to every true-born Briton, and in the conſequent judicial proceedings between the printers of The North Briton and the meſſengers and others, was ſo acceptable to the nation, that the city of London preſented him with the freedom of their corporation in a gold box, and deſired his picture, which was put up in Guildhall, with this inſcription:

HANC ICONEM
CAROLI PRATT, EQ.
SUMMI JUDICIS C. B.
IN HONOREM TANTI VIRI,
ANGLICÆ LIBERTATIS LEGE
ASSERTORIS,
S. P. Q. L.
IN CURIA MUNICIPALI
PONI JVSSERVNT
NONO KAL. MART. A. D. MDCCLXIV.
GULIELMO BRIDGEN, AR. PRÆ. VRB.

This portrait, painted by Reynolds, was engraved by Baſire. The corporations of Dublin, Bath, Exeter, and Norwich, paid him the like compliment; and in a petition entered in the journals of the city of Dublin, it was declared, that no man appeared to have acquitted himſelf in his high ſtation with ſuch becoming zeal for the honour and dignity of the crown, and the fulfilling his majeſty's moſt gracious intentions for preſerving the freedom and happineſs of his ſubjects, and ſuch invincible fortitude in adminiſtering juſtice and law, as the Right Honourable Sir Charles Pratt, knight, the preſent lord-chief-juſtice of his majeſty's court of common pleas in England, has ſhown in ſome late judicial determinations which muſt be remembered to his lordſhip's honour while and wherever Britiſh liberties are held ſacred.

Higher honours, however, than the breath of popular applauſe awaited Sir Charles Pratt. On the 16th of July 1765 he was created a peer of Great Britain, by the ſtyle and title of Lord Camden, Baron Camden, in the county of Kent; and July 30. 1766, on the reſignation of Robert earl of Northington, he was appointed lord high-chancellor of Great Britain; in which capacity he, in a ſpeech of two hours, declared, upon the firſt deciſion of the ſuit againſt the meſſengers who arreſted Mr Wilkes, that "it was the unanimous opinion of the whole court, that general warrants, except in caſes of high treaſon, were illegal, oppreſſive, and unwarrantable. He conducted himſelf in this high office ſo as to obtain the love and eſteem of all parties; but when the taxation of America was in agitation, he declared himſelf againſt it, and ſtrongly oppoſing it, was removed from his ſtation in 1770.

Upon the fall of Lord North he was again taken into the adminiſtration, and on the 27th of March 1782 appointed preſident of the council; an office which he reſigned in March 1783. On the 13th of May 1786, he was created Viſcount Bayham of Bayham abbey Kent, and Earl Camden.

Whether we conſider Earl Camden as a *ſtateſman*, called to that high ſituation by his talents; as a *lawyer*, defending, ſupporting, and enlarging the conſtitution; or as a *man* ſuſtaining both by his firmneſs and unſhaken integrity—in all he excites our general praiſe; and when we contemplate his high and exalted virtue, we muſt allow him to have been an honour to his country. He died on the 18th of April 1794 at his houſe in Hill-ſtreet, Berkeley-ſquare, being at that time preſident of his majeſty's moſt honourable privy-council, a governor of the charter-houſe, recorder of the city of Bath, and F. R. S.

He married Elizabeth, daughter and coheir of Nicholas Jafferys, Eſq; ſon and heir of Sir Jeffery Jafferys of Brecknock priory, knight, who died in December 1779, and by whom he had iſſue John Jafferys Pratt (now Lord Camden), born 1759, M. P. for Bath, commiſſioner of the admiralty, 1782, reſigned and re-appointed 1783; and four daughters, Frances, married, 1775, Robert Stewart, Eſq; of Mount Stewart, county of Down, 1779, and M. P. for that county; Elizabeth, ſingle; Sarah, married Nicholas Saintfield, Eſq; county of Down, 1779; Jane, married 1780 William Head James, Eſq; ſon and heir of Sir F. Head of Langley, county of Bucks. His ſeat at Camden place, Chiſelhurſt, was the reſidence of the great William Camden; on whoſe death it came by ſeveral intermediate owners to Weſton, Spencer, and Pratt, and was much improved by his Lordſhip. His remains were interred in the family burying-place at Seal, in Kent.

PRAXAGORAS, a native of Athens, at 19 years of age compoſed the Hiſtory of the Kings of Athens, in two books; and at 22 the Life of Conſtantine the Great, in which, though a pagan, he ſpeaks very advantageouſly of that prince. He alſo wrote the Hiſtory of Alexander the Great. He lived under Conſtantius about the year 345.

PRAXITELES, a very famous Greek ſculptor, who lived 330 years before Chriſt, at the time of the reign of Alexander the Great. All the ancient writers mention his ſtatues with a high commendation, eſpecially a Venus executed by him for the city of Cnidos, which was ſo admirable a piece, that king Nicomedes offered to releaſe the inhabitants from their tribute as the purchaſe of it; but they refuſed to part with it. The inhabitants of the iſle of Cos requeſted of Praxiteles a ſtatue of Venus; and in conſequence of this application the artiſt gave them their choice of two; one of which repreſented the goddeſs entirely naked, and the other covered with drapery. Both of theſe were of exquiſite workmanſhip; although the former was eſteemed the moſt beautiful, nevertheleſs the inhabitants of Cos had the wiſdom to give the preference to the latter, from a conviction that no motive whatever could juſtify their introducing into their city any indecent ſtatues or paintings, which are ſo likely to inflame the paſſions of young people, and lead them to immorality and vice. What a reproach will this be to many Chriſtians!—He was one of the gallants of Phryne the celebrated courteſan.

PRAYER, a ſolemn addreſs to God, which, when it is of any conſiderable length, conſiſts of *adoration, confeſſion, ſupplication, interceſſion,* and *thankſgiving.*

By *adoration* we expreſs our ſenſe of God's infinite perfections, his power, wiſdom, goodneſs, and mercy; and acknowledge that our conſtant dependence is upon Him by whom the univerſe was created and has been hitherto preſerved. By *confeſſion* is meant our acknowledgment of our manifold tranſgreſſions of the divine laws, and our conſequent unworthineſs of all the good things which we enjoy at preſent or expect to be conferred upon us hereafter. In *ſupplication* we intreat our omnipotent Creator and merciful Judge, not to deal with us after our iniquities, but to pardon our tranſgreſſions, and by his grace to enable us to live henceforth righteouſly, ſoberly, and godly, in this preſent world; and by Chriſtians this intreaty is always made in the name and through the mediation of Jeſus Chriſt, becauſe to them it is known that there is none other name under heaven given unto men whereby they may be ſaved. To theſe ſupplications for mercy we may likewiſe add our prayers for the neceſſaries of life; becauſe if we ſeek *firſt* the kingdom of God and his righteouſneſs, we are aſſured that ſuch things ſhall be added unto us. *Interceſſion* ſignifies thoſe petitions which we offer up for others, for friends, for enemies, for all men, eſpecially for our lawful governors, whether ſupreme or ſubordinate. And *thankſgiving* is the expreſſion of our gratitude to God, the giver of every good and perfect gift, for all the benefits enjoyed by us and others, for the means of grace, and for the hope of glory. Such are the component parts of a regular and ſolemn prayer, adapted either for the church or for the cloſet. But an ejaculation to God, conceived on any emergency, is likewiſe a prayer, whether it be uttered by the voice or ſuffered to remain a mere affection of the mind; becauſe the Being to whom it is addreſſed diſcerneth the thoughts of the heart.

That prayer is a duty which all men ought to perform with humility and reverence, has been generally acknowledged as well by the untaught barbarian as by the enlightened Chriſtian; and yet to this duty objections have been made by which the underſtanding has been bewildered in ſophiſtry and affronted with jargon. "If God be independent, omnipotent, and poſſeſſed of every other perfection, what pleaſure, it has been aſked, can he take in our acknowledgment of theſe perfections? If he knows all things paſt, preſent, and future, where is the propriety of our confeſſing our ſins unto him? If he is a benevolent and merciful Being, he will pardon our ſins, and grant us what is needful for us without our ſupplications and intreaties; and if he be likewiſe poſſeſſed of infinite wiſdom, it is certain that no importunities of ours will prevail upon him to grant us what is improper, or for our ſakes to change the equal and ſteady laws by which the world is governed.

"Shall burning Ætna, if a ſage requires,
"Forget to thunder, and recal her fires?
"On air or ſea new motions be impreſt,
"Oh blameleſs Bethel! to relieve thy breaſt?
"When the looſe mountain trembles from on high,
"Shall gravitation ceaſe, if you go by?
"Or ſome old temple, nodding to its fall,
"For Chartres' head reſerve the hanging wall*?"

Such are the moſt plauſible objections which are uſually made to the practice of prayer; and though they have been ſet off with all the art of the metaphyſical wrangler, and embelliſhed with all the graces of the poetry of Pope, they appear to us ſuch groſs ſophiſms as can operate only on a very unthinking head, or on a very corrupt heart. For if God certainly exiſts, and there is not a mathematical theorem capable of more rigid demonſtration, it is obvious that no man can think of ſuch a being without having his mind ſtrongly impreſſed with the conviction of his own conſtant dependence upon him; nor can he "contemplate the heavens, the work of God's hands, the moon, and the ſtars which he has ordained," without forming the moſt ſublime conceptions that he can of the Divine power, wiſdom, and goodneſs, &c But ſuch conviction, and ſuch conceptions, whether clothed in words or not, are to all intents and purpoſes what is meant by adoration; and are as well known to the Deity while they remain the ſilent affections of the heart, as after they are ſpoken in the beginning of a prayer. Our adoration, therefore, is not expreſſed for the purpoſe of giving information to God, who underſtandeth our thoughts afar off; but merely, when the prayer is private, becauſe we cannot think any more than ſpeak without words, and becauſe the very *ſound* of words that are well choſen affects the heart, and helps to fix our attention: and as the Being who ſees at once the paſt, preſent, and to come, and to whom a thouſand years are but as one day, ſtands not in need of our information; ſo neither was it ever ſuppoſed by a man of rational piety, that he takes pleaſure on his *own* account in hearing his perfections enumerated by creatures of yeſterday; for being independent, he has no paſſions to be gratified, and being ſelf-ſufficient, he was as happy when exiſting alone as at that moment "when the morning ſtars ſang together, and all the ſons of God ſhouted for joy." Adoration is therefore proper only as it tends to preſerve in our minds juſt notions of the Creator and Governor of the world, and of our own conſtant dependence upon him; and if ſuch notions be uſeful to ourſelves, who have a part to act in the ſcale of exiſtence, upon which our happineſs depends (a propoſition which no theiſt will controvert), adoration muſt be acceptable to that benevolent God, who, when creating the world, could have no other end in view than to propogate happineſs. Se METAPHYSICS, n° 312.

By the ſame mode of reaſoning, it will be eaſy to ſhow the duty of *confeſſion* and *ſupplication*. We are not required to confeſs our ſins unto God, becauſe he is ignorant of them; for he is ignorant of nothing. If he were, no reaſon could be aſſigned for our divulging to our judge actions deſerving of puniſhment. Neither are we required to cry for mercy, in order to move him in whom there is no variableneſs, neither ſhadow of turning. The Being that made the world, governs it by laws that are inflexible, becauſe they are the beſt; and to ſuppoſe that he can be induced by prayers, oblations, or ſacrifices, to vary his plan of government, is an impious thought, which degrades the Deity to a level with man. One of theſe inflexible laws is the connection eſtabliſhed between certain diſpoſitions of mind and human happineſs. We are enjoined to purſue a particular courſe of conduct under the denomination of virtue, not becauſe our virtuous actions can in any degree be of advantage to him by whom we were created, but becauſe they neceſſarily generate in our own minds thoſe diſpoſitions which are eſſential to our ultimate happineſs. A man of a malignant, arrogant, or ſenſual diſpoſition, would have no enjoyment in that heaven, where all are actuated by a ſpirit of love and purity; and it is doubtleſs for this reaſon among others, that the Chriſtian religion prohibits malice, arrogance, and ſenſuality, among her votaries, and requires the cultivation of the oppoſite virtues. But a perſon who has deviated far from his duty cannot think of returning, unleſs he be previouſly convinced that he has gone aſtray. Such conviction, whenever he obtains it, will neceſſarily impreſs upon his mind a ſenſe of his own danger, and fill his heart with ſorrow and remorſe for having tranſgreſſed the laws eſtabliſhed by the moſt benevolent of all Beings for the propagation of univerſal felicity. This conviction of error, this ſenſe of danger, and this compunction for having tranſgreſſed, are all perceived by the deity as ſoon as they take place in the mind of the ſinner; and he is required to *confeſs* his ſins, only becauſe the act of confeſſion tends to imprint more deeply on his mind his own unworthineſs, and the neceſſity of returning immediately into the paths of that virtue of which all the ways are pleaſantneſs and all the paths are peace.

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* Eſſay on Man.

In the objection, it is taken for granted, that if God be a benevolent and merciful Being, he will pardon our ſins, and grant us what is needful for us, whether we ſupplicate him or not: but this is a groſs and palpable miſtake, ariſing from the objector's ignorance of the end of virtue and the nature of man. Until a man be ſenſible of his ſins and his danger, he is for the reaſon already aſſigned incapable of pardon, becauſe his diſpoſition is incompatible with the happineſs of the bleſſed. But whenever he acquires this conviction it is impoſſible for him not to form a *mental wiſh* that he may be pardoned; and this wiſh being perceptible to the all-ſeeing eye of his Judge, forms the ſum and ſubſtance of a ſupplication for mercy. If he clothe it in words, it is only for a reaſon ſimilar to that which makes him adore his Creator and confeſs his ſins in words, that juſt notions may be more deeply imprinted on his own mind. The ſame reaſoning holds good with reſpect to thoſe prayers which we put up for temporal bleſſings, for protection and ſupport in our journey through life. We are told by high authority, that "the Lord is nigh unto all them that call upon him, to all that call upon him in truth." This, however, is not becauſe he is attracted or delighted by their prayers and intreaties, but becauſe thoſe prayers and intreaties fit ſuch as offer them for receiving thoſe benefits which he is at all times ready to pour upon all mankind. In his eſſence God is equally preſent with the righteous and with the wicked, with thoſe who pray, and with thoſe who pray not; for "the eyes of the Lord are in every place beholding the evil and the good." But as the atmoſphere equally ſurrounds every perſon upon this globe, and yet in its ſtate of greateſt purity does not affect the aſthmatic as it affects thoſe who are whole; ſo the Divine preſence, though eſſentially the ſame everywhere, yet does not protect the impious as it protects the devout, becauſe the impious are not in a ſtate capable of the Divine protection. The end for which God requires the exerciſe of prayer as a duty, is not his benefit but ours; becauſe it is a mean to generate in the petitioner ſuch a diſpoſition of mind as muſt render him a ſpecial object of that love and that providential care which extend over the whole creation.

That part of the objection which reſults from the conſideration of the fixed laws of nature, and which the poet has ſo finely illuſtrated, preſents, it muſt be confeſſed, conſiderable difficulties; but none which to us appear inſurmountable. If, indeed, we ſuppoſe that in the original conſtitution of things, when the laws of nature were eſtabliſhed, a determinate duration was given to the top of the mountain and the nodding temple, without any regard to foreſeen conſequences, it would undoubtedly be abſurd and perhaps impious to expect the law of gravitation to be ſuſpended by the prayers of a good man, who ſhould happen to be paſſing at the inſtant decreed for the fall of theſe objects. But of ſuch a conſtitution there is ſo far from being evidence, that it appears not to be conſiſtent with the wiſdom and goodneſs of the Author of nature. This world was undoubtedly formed for the habitation of man and of other animals. If ſo, we muſt neceſſarily ſuppoſe, that in the eſtabliſhing of the laws of Nature, God adjuſted them in ſuch a manner as he ſaw would beſt ſerve the accommodation of thoſe ſentient beings for whoſe accommodation alone they were to be eſtabliſhed. Let it then be admitted, that all the human beings who were ever to exiſt upon this globe, with all their thoughts, words, and actions, were at that important moment preſent to the divine intellect, and it ſurely will not be impoſſible to conceive, that in conſequence of the foreſeen danger and prayers of a good man, the determinate duration of the mountain and the tower might be either lengthened or ſhortened to let him eſcape. This idea of providence, and of the efficacy of prayer, is thus illuſtrated by Mr Wollaſton *. "Suppoſe M (ſome man) certainly to *foreknow*, by ſome means or other, that, when he ſhould come to be upon his death-bed, L would *petition* for ſome *particular legacy*, in a manner ſo earneſt and humble, and with ſuch a good diſpoſition, as would render it proper to grant his requeſt: and upon this, M makes his *laſt-will*, by which he deviſes to L that which was to be aſked, and then locks up the *will*; and all this many years before the death of M, and whilſt L had yet no expectation or thought of any ſuch thing. When the time comes, the *petition* is made and *granted*; not by making any *new* will, but by the old one already made, and without alteration: which legacy had, notwithſtanding that, never been left, had the petition never been preferred. The grant may be called the effect of a future act, and depends as much upon it as if it had been made after the act. So, if it had been foreſeen, that L would not *ſo much as aſk*, and he had been therefore left out of the will, this *præterition* would have been cauſed by his carriage, though much later than the date of the will. In all this nothing is hard to be admitted, if M be allowed to foreknow the caſe. And thus the *prayers* which good men offer to the *all-knowing* God, and the *neglect of prayers* by others, may find fitting effects *already* forecaſted in the courſe of nature."

This ſolution of the difficulty preſents indeed to the mind a prodigious ſcheme, in which all things to come are, as it were, comprehended under one view, and eſtimated and compared together. But when it is conſidered what a maſs of wonders the univerſe is in other reſpects; what an incomprehenſibly great and perfect Being God is; that he cannot be ignorant of any thing, no not of the future wants and deportments of particular men; and that all things which derive their exiſtence from him muſt be conſiſtent with one another—it muſt ſurely be confeſſed that ſuch an adjuſtment of phyſical cauſes to moral volitions is within the compaſs of infinite power and perfect wiſdom.

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* Religion of Nature delineated.

To that part of a prayer which we have termed interceſſion, it has been objected, that "to intercede for others is to preſume that we poſſeſs an intereſt with the Deity upon which their happineſs and even the proſperity of whole communities depends." In anſwer to this objection, it has been obſerved by an ingenious and uſeful writer †, that "how unequal ſoever our knowledge of the divine economy may be to a complete ſolution of this difficulty, which may require a comprehenſion of the entire plan, and of all the ends of God's moral government, to explain it ſatisfactorily, we can yet underſtand one thing concerning it, that it is, after all, nothing more than the making of one man the inſtrument of happineſs and miſery to another; which is perfectly of a piece with the courſe and order that obtain, and which we muſt believe were intended to obtain in human affairs. Why may we not be aſſiſted by the *prayers* of other men, as well as we are beholden for our *ſupport to their labour?* Why may not our happineſs be made in ſome caſes to depend upon the interceſſion as it certainly does in many upon the good offices of our neighbours? The happineſs and miſery of great numbers we ſee oftentimes at the diſpoſal of one man's choice, or liable to be much affected by his conduct: what greater difficulty is there in ſuppoſing, that the prayers of an individual may avert a calamity from multitudes, or be accepted to the benefit of whole communities."

Theſe obſervations may perhaps be ſufficient to remove the force of the objection, but much more may be ſaid for the practice of mutual interceſſion. If it be one man's duty to intercede for another, it is the duty of that other to intercede for him; and if we ſet aſide the particular relations which ariſe from blood, and from particular ſtations in ſociety, mutual interceſſion muſt be equally the duty of all mankind. But there is nothing (we ſpeak from our own experience, and appeal to the experience of our readers) which has ſo powerful a tendency to generate in the heart of any perſon good-will towards another as the conſtant practice of praying to God for his happineſs. Let a man regularly pray for his enemy with all that ſeriouſneſs which devotion requires, and he will not long harbour reſentment againſt him. Let him pray for his friend with that ardour which friendſhip naturally inſpires, and he will perceive his attachment to grow daily and daily ſtronger. If, then, univerſal benevolence, or charity, be a diſpoſition which we ought to cultivate in ourſelves, mutual interceſſion is undeniably a duty, becauſe nothing contributes ſo effectually to the acquiſition of that ſpirit which an apoſtle terms the end of the commandment.

When it is ſaid, that by interceding for kings, and all in authority, we ſeem to conſider the proſperity of communities as depending upon our intereſt with God, the objector miſtakes the nature and end of theſe interceſſions. In the proſperity of any community conſiſts great part of the happineſs of its individual members; but that proſperity depends much upon the conduct of its governors. When, therefore, individuals intercede for their governors, the ultimate object of their prayers muſt be conceived to be their own good. As it is equally the duty of all the members of the community to pray for their governors, ſuch interceſſions are the prayers of the whole community for itſelf, and of every individual for himſelf. So that in this view of the caſe, the moſt juſt, we apprehend, that can be taken of it, it is not true that ſupplications and interceſſions for kings and all in authority are the prayers of one individual for another, but the prayers of many individuals for that body of which each of them knows himſelf to be a member.

Having evinced the duty of adoration, confeſſion, ſupplication, and interceſſion, we need not ſurely waſte our reader's time with a formal and laboured vindication of thankſgiving. Gratitude for benefits received is ſo univerſally acknowledged to be a virtue, and ingratitude is ſo deteſtable a vice, that no man who lays claim to a moral character will dare to affirm that we ought not to have a juſt ſenſe of the goodneſs of God in preſerving us from the numberleſs dangers to which we are expoſed, and "in giving us rain from heaven, and fruitful ſeaſons, filling our hearts with food and gladneſs." But if we have this ſenſe, whether we expreſs it in words or not, we offer to God thankſgiving; becauſe every movement of the heart is open and expoſed to his all-ſeeing eye.

In this article we have treated of prayer in general, and as the private duty of every individual; but there ought to be *public* as well as *private* prayer, which ſhall be conſidered afterwards. (See WORSHIP.) We have likewiſe obſerved, that the prayers of every Chriſtian ought to be offered in the name and through the mediation of Jeſus Chriſt, for which the reaſon will be ſeen in the article THEOLOGY. We ſhall conclude our reflections on the general duty, with obſerving, that nothing ſo forcibly reſtrains from ill as the remembrance of a recent addreſs to heaven for pretection and aſſiſtance. After having petitioned for power to reſiſt temptation, there is ſo great an incongruity in not continuing the ſtruggle, that we bluſh at the thought, and perſevere leſt we loſe all reverence for ourſelves. After fervently devoting our ſouls to God, we ſtart with horror at immediate apoſtacy: every act of deliberate wickedneſs is then complicated with hypocriſy and ingratitude: it is a mockery of the Father of Mercies, the forfeiture of that peace in which we cloſed our addreſs, and a renunciation of the hope which that addreſs inſpired. But if prayer and immorality be thus incompatible, ſurely the former ſhould not be neglected by thoſe who contend that moral virtue is the ſummit of human perfection.

PREACHING. See DECLAMATION, Art. I.—The word is derived from the Hebrew *paraſch*, *expoſuit*, "he expounded."

PREADAMITE, a denomination given to the inhabitants of the earth, conceived, by ſome people, to have lived before Adam.

Iſaac de la Pereyra, in 1655, publiſhed a book to evince the reality of Preadamites, by which he gained a conſiderable number of proſelytes to the opinion: but the anſwer of Demarets, profeſſor of theology at Groningen, publiſhed the year following, put a ſtop to its progreſs; though Pereyra made a reply.

His ſyſtem was this: The Jews he calls *Adamites*, and ſuppoſes them to have iſſued from Adam; and gives the title *Preadamites* to the Gentiles, whom he ſuppoſes to have been a long time before Adam. But this being expreſsly contrary to the firſt words of Geneſis, Pereyra had recourſe to the fabulous antiquities of the Egyptians and Chaldeans, and to ſome idle rabbins, who imagined there had been another world before that

† Mr Paley.

deſcribed by Moſes. He was apprehended by the inquiſition in Flanders, and very roughly uſed, though in the ſervice of the dauphin. But he appealed from their ſentence to Rome; whither he went in the time of Alexander VII. and where he printed a retraction of his book of Preadamites. See PRE-EXISTENCE.

PREAMBLE, in law, the beginning of an act of a legiſlature, &c. which ſerves to open the intent of the act, and the miſchiefs intended to be remedied by it.

PREBEND, the maintenance a prebendary receives out of the eſtate of a cathedral or collegiate church. Prebends are diſtinguiſhed into ſimple and dignitary: a ſimple prebend has no more than the revenue for its ſupport; but a prebend with dignity has always a juriſdiction annexed to it.

PREBENDARY, an eccleſiaſtic who enjoys a prebend.

The difference between a prebendary and a canon is, that the former receives his prebend in conſideration of his officiating in the church, but the latter merely by his being received into the cathedral or college.

PRECARIUM, in Scots law. See LAW, N° clxxiii. 9.

PRECEDENCE, in Europe, a place of honour to which a perſon is entitled. This is either of courteſy or of right. The former is that which is due to age, eſtate, &c. which is regulated by cuſtom and civility: the latter is ſettled by authority; and when broken in upon gives an action at law.

In Great Britain, the order of precedency is as follows: The king; the princes of the blood; the archbiſhop of Canterbury; the lord high chancellor; the archbiſhop of York; the lord treaſurer of England; the lord preſident of the council; the lord privy ſeal; dukes; the eldeſt ſons of dukes of the blood royal; marquiſſes; dukes eldeſt ſons; earls; marquiſſes eldeſt ſons; dukes younger ſons; viſcounts; earls eldeſt ſons; marquiſſes younger ſons; biſhops; barons; ſpeaker of the houſe of commons; lord commiſſioner of the great ſeal; viſcounts eldeſt ſons; earls younger ſons; barons eldeſt ſons, privy counſellors not peers; chancellor of the exchequer; chancellor of the duchy; knights of the garter not peers; lord chief juſtice of the king's bench; maſter of the rolls; lord chief juſtice of the common pleas; lord chief baron of the exchequer; puiſne judges and barons; knights banneret, if made in the field; maſters in chancery; viſcounts younger ſons; barons younger ſons; baronets; knights banneret; knights of the Bath; knights bachelors; baronets eldeſt ſons; knights eldeſt ſons; baronets younger ſons; knights younger ſons; field and flag officers; doctors graduate; ſerjeants at law; eſquires; gentlemen bearing coat armour; yeomen; tradeſmen; artificers; labourers.—*Note*, The ladies, except thoſe of archbiſhops, biſhops, and judges, take place according to the degree of quality of their huſbands; and unmarried ladies take place according to that of their fathers.

PRECEDENT, in law, a caſe which has been determined, and which ſerves as a rule for all of the ſame nature.

PRECENTOR, a dignity in cathedrals, popularly called the *chantor*, or *maſter of the choir*.

PRECEPT, in law, a command in writing ſent by a chief juſtice or juſtice of the peace, for bringing a perſon, record, or other matter before him.

Precept of Clare Conſtat in Scots law. See LAW, Part III. n° clxxx. 28.

Precept of Seiſin, in Scots law. See LAW, Part III. n° clxix. 16.

PRECEPTIVE, any thing which gives or contains precepts.

Preceptive Poetry. See POETRY n° 146, &c.

1 Diurnal revolution of the ſtarry heavens.

PRECESSION OF THE EQUINOXES. The moſt obvious of all the celeſtial motions is the diurnal revolution of the ſtarry heavens. The whole appears to turn round an imaginary AXIS, which paſſes through two oppoſite points of the heavens, called the *poles*. One of theſe is in our ſight, being very near the ſtar and in the tail of the little bear. The great circle which is equidiſtant from both poles divides the heavens into the northern and ſouthern hemiſpheres, which are equal. It is called the *equator*, and it cuts the horizon in the eaſt and weſt points, and every ſtar in it is 12 ſidereal hours above and as many below the horizon, in each revolution.

2 Obſervations of the Aſiatic ſhepherds.

The ſun's motions determine the length of day and night, and the viciſſitudes of the ſeaſons. By a long ſeries of obſervations, the ſhepherds of Aſia were able to mark out the ſun's path in the heavens; he being always in the oppoſite point to that which comes to the meridian at midnight, with equal but oppoſite declination. Thus they could tell the ſtars among which the ſun then was, although they could not ſee them. They diſcovered that his path was a great circle of the heavens, afterward called the ECLIPTIC; which cuts the Equator in two oppoſite points, dividing it, and being divided by it, into two equal parts. They farther obſerved, that when the ſun was in either of theſe points of interſection, his circle of diurnal revolution coincided with the equator, and therefore the days and nights were equal. Hence the equator came to be called the EQUINOCTIAL LINE, and the points in which it cuts the ecliptic were called the EQUINOCTIAL POINTS, and the ſun was then ſaid to be in the equinoxes. One of theſe was called the VERNAL and the other the AUTUMNAL EQUINOX.

3 To determine the time of the ſun's occupying the equinoctial points.

It was evidently an important problem in practical aſtronomy to determine the exact moment of the ſun's occupying theſe ſtations; for it was natural to compute the courſe of the year from that moment. Accordingly this has been the leading problem in the aſtronomy of all nations. It is ſuſceptible of conſiderable preciſion, without any apparatus of inſtruments. It is only neceſſary to obſerve the ſun's declination on the noon of two or three days before and after the equinoctial day. On two conſecutive days of this number, his declination muſt have changed from north to ſouth, or from ſouth to north. If his declination on one day was obſerved to be 21′ north, and on the next 5′ ſouth, it follows that his declination was nothing, or that he was in the equinoctial point about 23 minutes after 7 in the morning of the ſecond day. Knowing the preciſe moments, and knowing the rate of the ſun's motion in the ecliptic, it is eaſy to aſcertain the preciſe point of the ecliptic in which the equator interſected it.

4 Hipparchus's diſcoveries.

By a ſeries of ſuch obſervations made at Alexandria between the years 161 and 127 before Chriſt, Hipparchus the father of our aſtronomy found that the point of the autumnal equinox was about ſix degrees to the eaſtward of the ſtar called SPICA VIRGINIS. Eager to determine every thing by multiplied obſervations, he ranſacked all the Chaldean, Egyptian, and other records, to which his travels could procure him acceſs, for obſervations of the ſame kind; but he does not mention his having found any. He found, however, ſome obſervations of Ariſtillus and Timochares made about 150 years before. From theſe it appeared evident that the point of the autumnal equinox was then about eight degrees eaſt of the ſame ſtar. He diſcuſſes theſe obſervations with great ſagacity and rigour; and, on their authority, he aſſerts that the equinoctial points are not fixed in the heavens, but move to the weſtward about a degree in 75 years or ſomewhat leſs.

5
Why called the preceſſion of the equinoxes.

This motion is called the PRECESSION OF THE EQUINOXES, becauſe by it the time and place of the ſun's equinoctial ſtation precedes the uſual calculations: it is fully confirmed by all ſubſequent obſervations. In 1750 the autumnal equinox was obſerved to be 20° 21′ weſtward of ſpica virginis. Suppoſing the motion to have been uniform during the period of ages, it follows that the annual preceſſion is about $50''\frac{1}{3}$; that is, if the celeſtial equator cuts the ecliptic in a particular point on any day of this year, it will on the ſame day of the following year cut it in a point $50''\frac{1}{3}$ to the weſt of it, and the ſun will come to the equinox 20′ 23″ before he has completed his round of the heavens. Thus the equinoctial or tropical year, or true year of ſeaſons, is ſo much ſhorter than the revolution of the ſun or the ſidereal year.

6
Importance of the diſcovery.

It is this diſcovery that has chiefly immortalized the name of Hipparchus, though it muſt be acknowledged that all his aſtronomical reſearches have been conducted with the ſame ſagacity and intelligence. It was natural therefore for him to value himſelf highly for the diſcovery. It muſt be acknowledged to be one of the moſt ſingular that has been made, that the revolution of the whole heavens ſhould not be ſtable, but its axis continually changing. For it muſt be obſerved, that ſince the equator changes its poſition, and the equator is only an imaginary circle, equidiſtant from the two poles or extremities of the axis; theſe poles and this axis muſt equally change their poſitions. The equinoctial points make a complete revolution in about 25745, the equator being all the while inclined to the ecliptic in nearly the ſame angle. Therefore the poles of this diurnal revolution muſt deſcribe a circle round the poles of the ecliptic at the diſtance of about $23\frac{1}{2}$ degrees in 25745 years; and in the time of Timochares the north pole of the heavens muſt have been 30 degrees eaſtward of where it now is.

7
Hipparchus has been accuſed of plagiariſm,

Hipparchus has been accuſed of plagiariſm and inſincerity in this matter. It is now very certain that the preceſſion of the equinoxes was known to the aſtronomers of India many ages before the time of Hipparchus. It appears alſo that the Chaldeans had a pretty accurate knowledge of the year of ſeaſons. From their ſaros we deduce their meaſure of this year to be 365 days 5 hours 49 minutes and 11 ſeconds, exceeding the truth only by 26″, and much more exact than the year of Hipparchus. They had alſo a ſidereal year of 365 days 6 hours 11 minutes. Now what could occaſion an attention to two years, if they did not ſuppoſe the equinoxes moveable? The Egyptians alſo had a knowledge of ſomething equivalent to this: for they had diſcovered that the dog-ſtar was no longer the faithful forewarner of the overflowing of the Nile; and they combined him with the ſtar Fomalhaſet* in their myſtical kalendar. This knowledge is alſo involved in the precepts of the Chineſe aſtronomy, of much older date than the time of Hipparchus.

8
But falſely,

But all theſe acknowledged facts are not ſufficient for depriving Hipparchus of the honour of the diſcovery, or fixing on him the charge of plagiariſm. This motion was a thing unknown to the aſtronomers of the Alexandrian ſchool, and it was pointed out to them by Hipparchus in the way in which he aſcertained every other poſition in aſtronomy, namely, as the mathematical reſult of actual obſervations, and not as a thing deducible from any opinions on other ſubjects related to it. We ſee him, on all other occaſions, eager to confirm his own obſervations and his deductions from them, by every thing he could pick up from other aſtronomers; and he even adduced the abovementioned practice of the Egyptians in corroboration of his doctrine. It is more than probable then that he did not know any thing more. Had he known the Indian preceſſion of 54″ annually, he had no temptation whatever to withhold him from uſing it in preference to one which he acknowledges to be inaccurate, becauſe deduced from the very ſhort period of 150 years, and from the obſervations of Timochares, in which he had no great confidence.

9
Heavenly motions accounted for by the Copernican ſyſtem.

This motion of the ſtarry heavens was long a matter of diſcuſſion, as a thing for which no phyſical reaſon could be aſſigned. But the eſtabliſhment of the Copernican ſyſtem reduced it to a very ſimple affair; the motion which was thought to affect all the heavenly bodies, is now acknowledged to be a deception, or a falſe judgment from the appearances. The earth turns round its own axis while it revolves round the ſun, in the ſame manner as we may cauſe a child's top to ſpin on the brim of a mill-ſtone, while the ſtone is turning ſlowly round its axis. If the top ſpin ſteadily, without any wavering, its axis will always point to the zenith of the heavens; but we frequently ſee, that while it ſpins briſkly round its axis, the axis itſelf has a ſlow conical motion round the vertical line, ſo that, if produced, it would ſlowly deſcribe a circle in the heavens round the zenith point. The flat ſurface of the top may repreſent the terreſtrial equator, gradually turning itſelf round on all ſides. If this top were formed like a ball, with an equatorial circle on it, it would repreſent the whole motion very prettily, the only difference being, that the ſpinning motion and this wavering motion are in the ſame direction; whereas the diurnal rotation and the motion of the equinoctial points are in contrary directions. Even this diſſimilarity may be removed, by making the top turn on a cap, like the card of a mariner's compaſs.

10
And the earth's.

It is now a matter fully eſtabliſhed, that while the earth revolves round the ſun from weſt to eaſt, in the plane of the ecliptic, in the courſe of a year it turns round its own axis from weſt to eaſt in 23h 56′ 4″, which axis is inclined to this plane in an angle of nearly 23° 28′; and that this axis turns round a line perpendicular to the ecliptic in 25,745 years from eaſt to weſt, keeping nearly the ſame inclination to the ecliptic.—By this means, its pole in the ſphere of the ſtarry heavens deſcribes a circle round the pole of the ecliptic at the diſtance of 23° 28′ nearly. The conſequence of this muſt be, that the terreſtrial equator, when produced to the ſphere of the ſtarry heavens, will cut the ecliptic in two oppoſite points, through which the ſun muſt paſs when he makes the day and night equal; and that theſe points muſt ſhift to the weſtward, at the rate of 50⅓ ſeconds annually, which is the preceſſion of the equinoxes. Accordingly this has been the received doctrine among aſtronomers for nearly three centuries, and it was thought perfectly conformable to appearances.

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* See Dupins ſur le zodiaque des Egyptiens, Mem. de l'Acad. des Inſcrip.

11
Bradley's attempt to diſcover the parallax of the earth's orbit.

But Dr Bradley, the moſt ſagacious of modern aſtronomers, hoped to diſcover the parallax of the earth's orbit by obſervations of the actual poſition of the pole of the celeſtial revolution. Dr Hooke had attempted this before, but with very imperfect inſtruments. The art of obſerving being now prodigiouſly improved, Dr Bradley reſumed this inveſtigation. It will eaſily appear, that if the earth's axis keeps parallel to itſelf, its extremity muſt deſcribe in the ſphere of the ſtarry heavens a figure equal and parallel to its orbit round the ſun; and if the ſtars be ſo near that this figure is a viſible object, the pole of diurnal revolution will be in different diſtinguiſhable points of this figure. Conſequently, if the axis deſcribes the cone already mentioned, the pole will not deſcribe a circle round the pole of the ecliptic, but will have a looped motion along this circumference, ſimilar to the abſolute motion of one of Jupiter's ſatellites, deſcribing an epicycle whoſe centre deſcribes the circle round the pole of the ecliptic.

12
Difficulties in the attempt obviated by accident.

He accordingly obſerved ſuch an epicyclical motion, and thought that he had now overcome the only difficulty in the Copernican ſyſtem; but, on maturely conſidering his obſervations, he found this epicycle to be quite inconſiſtent with the conſequences of the annual parallax, and it puzzled him exceedingly. One day, while taking the amuſement of ſailing about on the Thames, he obſerved, that every time the boat tacked, the direction of the wind, eſtimated by the direction of the vane, ſeemed to change. This immediately ſuggeſted to him the cauſe of his obſerved epicycle, and he found it an optical illuſion, occaſioned by a combination of the motion of light with the motion of his teleſcope while obſerving the polar ſtars. Thus he unwittingly eſtabliſhed an incontrovertible argument for the truth of the Copernican ſyſtem, and immortalized his name by his diſcovery of the ABERRATION of the ſtars.

13
His further inveſtigation of the ſubject.

He now engaged in a ſeries of obſervations for aſcertaining all the circumſtances of this diſcovery. In the courſe of theſe, which were continued for 28 years, he diſcovered another epicyclical motion of the pole of the heavens, which was equally curious and unexpected. He found that the pole deſcribed an epicycle, whoſe diameter was about 18″, having for its centre that point of the circle round the pole of the ecliptic in which the pole would have been found independent of this new motion. He alſo obſerved, that the period of this epicyclical motion was 18 years and ſeven months. It ſtruck him, that this was preciſely the period of the revolution of the nodes of the moon's orbit. He gave a brief account of theſe reſults to Lord Macclesfield, then preſident of the Royal Society, in 1747. Mr Machin, to whom he alſo communicated the obſervations, gave him in return a very neat mathematical hypotheſis, by which the motion might be calculated.

Plate CCCCXIV

14
Mathematical theory if the poles of the equator be ſuppoſed to deſcribe a circle.

Let E (fig. 1.), be the pole of the ecliptic, and SPQ a circle diſtant from it 23° 28′, repreſenting the circle deſcribed by the pole of the equator during one revolution of the equinoctial points. Let P be the place of this laſt mentioned pole at ſome given time. Round P deſcribe a circle ABCD, whoſe diameter AC is 18″. The real ſituation of the pole will be in the circumference of this circle; and its place, in this circumference, depends on the place of the moon's aſcending node. Draw EPF and GPL perpendicular to it; let GL be the colure of the equinoxes, and EF the colure of the ſolſtices. Dr Bradley's obſervations ſhowed that the pole was in A when the node was in L, the vernal equinox. If the node recede to H, the winter ſolſtice, the pole is in B. When the node is in the autumnal equinox at G, the pole is at C; and when the node is in F, the ſummer ſolſtice, the pole is in D. In all intermediate ſituations of the moon's aſcending node, the pole is in a point of the circumference ABCD, three ſigns or 90° more advanced.

15
More exact if an ellipſe be ſubſtituted for the circle.

Dr Bradley, by comparing together a great number of obſervations, found that the mathematical theory, and the calculation depending on it, would correſpond much better with the obſervations, if an ellipſe were ſubſtituted for the circle ABCD, making the longer axis AC 18″, and the ſhorter, BD, 16″. Mr d'Alembert determined, by the phyſical theory of gravitation, the axes to be 18″, and 13″, 4.

16
Theſe obſervations and this theory are facts in aſtronomy.

Theſe obſervations, and this mathematical theory, muſt be conſidered as ſo many facts in aſtronomy, and we muſt deduce from them the methods of computing the places of all celeſtial phenomena, agreeable to the univerſal practice of determining every point of the heavens by its longitude, latitude, right aſcenſion, and declination.

17
Obliquity of the ecliptic.

It is evident, in the firſt place, that this equation of the pole's motion makes a change in the obliquity of the ecliptic. The inclination of the equator to the ecliptic is meaſured by the arch of a great circle intercepted between their poles. Now, if the pole be in O inſtead of P, it is plain that the obliquity is meaſured by EO inſtead of EP. If EP be conſidered as the mean obliquity of the ecliptic, it is augmented by 9″ when the moon's aſcending node is in the vernal equinox, and conſequently the pole in A. It is, on the contrary, diminiſhed 9″ when the node is in the autumnal equinox, and the pole in C; and it is equal to the mean when the node is in the colure of the ſolſtices. This change of the inclination of the earth's axis to the plane of the ecliptic was called the NUTATION of the axis by Sir Iſaac Newton; who ſhowed, that a change of nearly a ſecond muſt obtain in a year by the action of the ſun on the prominent parts of the terreſtrial ſpheroid. But he did not attend to the change which would be made in this motion by the variation which obtains in the diſturbing force of the MOON, in conſequence of the different obliquity of her action on the equator, ariſing from the motion of her own oblique orbit. It is this change which now goes by the name NUTATION, and we owe its diſcovery entirely to Dr Bradley. The general change of the poſition of the earth's axis has been termed DEVIATION by modern aſtronomers.

18
Quantity of it eaſily aſcertained.

The quantity of this change of obliquity is eaſily aſcertained. It is evident, from what has been already ſaid, that when the pole is in O, the arch ADCO is equal to the node's longitude from the vernal equinox, and that PM is its coſine; and (on account of the ſmallneſs of AP in compariſon of EP) PM may be taken for the change of the obliquity of the ecliptic. This is therefore $= 9'' \times$ coſ. long. node, and is additive to the mean obliquity, while O is in the ſemicircle BAD, that is, while the longitude of the node is from 9 ſigns to 3 ſigns; but ſubtractive while the longitude of the node changes from 3 to 9 ſigns.

19 Change of the equinoctial points.

But the nutation changes alſo the longitudes and right aſcenſions of the ſtars and planets by changing the equinoctial points, and thus occaſioning an equation in the preceſſion of the equinoctial points. It was this circumſtance which made it neceſſary for us to conſider it in this place, while expreſsly treating of this preceſſion. Let us attend to this derangement of the equinoctial points.

20 Situation of the ſolſtitial and equinoctial colures.

The great circle or meridian which paſſes through the poles of the ecliptic and equator is always the ſolſtitial colure, and the equinoctial colure is at right angles to it: therefore when the pole is in P or in O, EP or EO is the ſolſtitial colure. Let S be any fixed ſtar or planet, and let SE be a meridian or circle of longitude; draw the circles of declination PS, OS, and the circles M′EM′, *m*E*m*′, perpendicular to PE, OE.

21 Equation of longitude from nutation of the earth's axis.

If the pole were in its mean place P, the equinoctial points would be in the ecliptic meridian M′EM′, or that meridian would paſs through the interſections of the equator and ecliptic, and the angle MES would meaſure the longitude of the ſtar S. But when the pole is in O, the ecliptic meridian *m*E*m*′ will paſs thro' the equinoctial points. The equinoctial points muſt therefore be to the weſtward of their mean place, and the equation of the preceſſion muſt be additive to that preceſſion; and the longitude of the ſtar S will now be meaſured by the angle *m*ES, which, in the caſe here repreſented, is greater than its mean longitude. The difference, or the equation of longitude, ariſing from the nutation of the earth's axis, is the angle OEP, or $\frac{\text{OM}}{\text{OE}}$. OM is the ſine of the angle CPO, which, by what has been already obſerved, is equal to the longitude of the node: Therefore OM is equal to $9'' \times$ long. node, and $\frac{\text{OM}}{\text{OE}}$ is equal to $\frac{9'' \times \text{ſin. long. node}}{\text{ſin. obliqy. eclip.}}$. This equation is additive to the mean longitude of the ſtar when O is in the ſemicircle CBA, or while the aſcending node is paſſing backwards from the vernal to the autumnal equinox but it is ſubtractive from it while O is in the ſemicircle ADC, or while the node is paſſing backwards from the autumnal to the vernal equinox; or, to expreſs it more briefly, the equation is ſubtractive from the mean longitude of the ſtar, while the aſcending node is in the firſt ſix ſigns, and additive to it while the node is in the laſt ſix ſigns.

This equation of longitude is the ſame for all the ſtars, for their longitude is reckoned on the ecliptic (which is here ſuppoſed invariable); and therefore is affected only by the variation of the point from which the longitude is computed.

22 Right aſcenſion ſuffers a double change.

The right aſcenſion, being computed on the equator, ſuffers a double change. It is computed from, or begins at, a different point of the equator, and it terminates at a different point; becauſe the equator having changed its poſition, the circles of declination alſo change theirs. When the pole is at P, the right aſcenſion of S from the ſolſtitial colure is meaſured by the angle SPE, contained between that colure and the ſtar's circle of declination. But when the pole is at O, the right aſcenſion is meaſured by the angle SOE, and the difference of SPE and SOE is the equation of right aſcenſion. The angle SOE conſiſts of two parts, GOE and GOS; GOE remains the ſame wherever the ſtar S is placed, but GOS varies with the place of the ſtar.—We muſt firſt find the variation by which GPE becomes GOE, which variation is common to all the ſtars. The triangles GPE, GOE, have a conſtant ſide GE, and a conſtant angle G; the variation PO of the ſide GP is extremely ſmall, and therefore the variation of the angles may be computed by Mr Cotes's Fluxionary Theorems. See Simpſon's *Fluxions*, § 253, &c. As the tangent of the ſide EP, oppoſite to the conſtant angle G, is to the ſine of the angle EPG, oppoſite to the conſtant ſide EG, ſo is PO the variation of the ſide GP, adjacent to the conſtant angle, to the variation x of the angle GPO, oppoſite to the conſtant ſide EG. This gives $x = \frac{9' \times \text{ſin. long. node}}{\text{tang. obl. eclip.}}$. This is ſubtractive from the mean right aſcenſion for the firſt ſix ſigns of the node's longitude, and additive for the laſt ſix ſigns. This equation is common to all the ſtars.

23 Other variations, &c.

The variation of the other part SOG of the angle, which depends on the different poſition of the hour circles PS and OS, which cauſes them to cut the equation in different points, where the arches of right aſcenſion terminate, may be diſcovered as follows. The triangles SPG, SOG, have a conſtant ſide SG, and a conſtant angle G. Therefore, by the ſame Coteſian theorem, tan. SP : ſin. SPG $=$ PO : y, and y, or the ſecond part of the nutation in right aſcenſion, $= \frac{9'' \times \text{ſin. diff. R. A. of ſtar and node}}{\text{cotan. declin. ſtar}}$.

24 Nutation affects the declinations of the ſtars.

The nutation alſo affects the declination of the ſtars: For SP, the mean codeclination, is changed into SO.—Suppoſe a circle deſcribed round S, with the diſtance SO cutting SP in f; then it is evident that the equation of declin. is Pf $=$ PO $\times$ coſine OPf $= 9'' \times$ ſign r. aſcen. of ſtar—long. of node.

25 A more exact mode of calculation.

Such are the calculations in conſtant uſe in our aſtronomical reſearches, founded on Machin's Theory. When ſtill greater accuracy is required, the elliptical theory muſt be ſubſtituted, by taking (as is expreſſed by the dotted lines) O in that point of the ellipſe deſcribed on the tranſverſe axis AC, where it is cut by OM, drawn according to Machin's theory. All the change made here is the diminution of OM in the ratio of 18 to 13,4, and a correſponding diminution of the angle CPO. The detail of it may be ſeen in De la Lande's *Aſtronomy*, art. 2874; but is rather foreign to our preſent purpoſe of explaining the preceſſion of the equinoxes. The calculations being in every caſe tedious, and liable to miſtakes, on account of the changes of the ſigns of the different equations, the zealous promoters of aſtronomy have calculated and publiſhed tables of all theſe equations, both on the circular and elliptical hypotheſis. And ſtill more to abridge calculations, which occur in reducing every aſtronomical obſervation, when the place of a phenomenon is deduced from a compariſon with known fixed ſtars, there have been publiſhed tables of nutation and preceſſion, for ſome hundreds of the principal ſtars, for every poſition of the moon's node and of the ſun.

26 Preceſſion of the equinoctial points, &c.

It now remains to conſider the preceſſion of the equinoctial points, with its equations, ariſing from the nutation of the earth's axis as a phyſical phenomenon, and to endeavour to account for it upon thoſe mechanical principles which have ſo happily explained all the other phenomena of the celeſtial motions.

27 Obſervations of Newton and others on this ſubject.

This did not eſcape the penetrating eye of Sir Iſaac Newton; and he quickly found it to be a conſequence, and the moſt beautiful proof, of the univerſal gravitation of all matter to all matter; and there is no part of his immortal work where his ſagacity and fertility of reſource ſhine more conſpicuouſly than in this inveſtigation. It muſt be acknowledged, however, that Newton's inveſtigation is only a ſhrewd gueſs, founded on aſſumptions, of which it would be extremely difficult to demonſtrate either the truth or falſity, and which required the genius of a Newton to pick out in ſuch a complication of abſtruſe circumſtances. The ſubject has occupied the attention of the firſt mathematicians of Europe ſince his time; and is ſtill conſidered as the moſt curious and difficult of all mechanical problems. The moſt elaborate and accurate diſſertations on the preceſſion of the equinoxes are thoſe of Sylvabella and Walmeſly, in the Philoſophical Tranſactions, publiſhed about the year 1754; that of Thomas Simpſon, publiſhed in his Miſcellaneous Tracts; that of Father Friſius, in the Memoirs of the Berlin Academy, and afterwards, with great improvements, in his Coſmographia; that of Euler in the Memoirs of Berlin; that of D'Alembert in a ſeparate diſſertation; and that of De la Grange on the Libration of the Moon, which obtained the prize in the Academy of Paris in 1769. We think the diſſertation of Father Friſius the moſt perſpicuous of them all, being conducted in the method of geometrical analyſis; whereas moſt of the others proceed in the fluxionary and ſymbolic method, which is frequently deficient in diſtinct notions of the quantities under conſideration, and therefore does not give us the ſame perſpicuous conviction of the truth of the reſults. In a work like ours, it is impoſſible to do juſtice to the problem, without entering into a detail which would be thought extremely diſproportioned to the ſubject by the generality of our readers. Yet thoſe who have the neceſſary preparation of mathematical knowledge, and wiſh to underſtand the ſubject fully, will find enough here to give them a very diſtinct notion of it; and in the article Rotation, they will find the fundamental theorems, which will enable them to carry on the inveſtigation. We ſhall firſt give a ſhort ſketch of Newton's inveſtigation, which is of the moſt palpable and popular kind, and is highly valuable, not only for its ingenuity, but alſo becauſe it will give our unlearned readers diſtinct and ſatisfactory conceptions of the chief circumſtances of the whole phenomena.

28 Sketch of Newton's inveſtigation of it. Plate CCCCXIV.

Let S (fig. 2.) be the Sun, E the Earth, and M the Moon, moving in the orbit NMCDn, which cuts the plane of the Ecliptic in the line of the nodes Nn, and has one half raiſed above it, as repreſented in the figure, the other half being hid below the Ecliptic. Suppoſe this orbit folded down; it will coincide with the Ecliptic in the circle N$mcdn$. Let EX repreſent the axis of this orbit, perpendicular to its plane, and therefore inclined to the Ecliptic. Since the Moon gravitates to the Sun in the direction MS, which is all above the Ecliptic, it is plain that this gravitation has a tendency to draw the Moon towards the Ecliptic. Suppoſe this force to be ſuch that it would draw the Moon down from M to i in the time that ſhe would have moved from M to t, in the tangent to her orbit. By the combination of theſe motions, the Moon will deſert her orbit, and deſcribe the line Mr, which makes the diagonal of the parallelogram; and if no farther action of the ſun be ſuppoſed, ſhe will deſcribe another orbit Mdn', lying between the orbit MCDn and the Ecliptic, and ſhe will come to the Ecliptic, and paſs through it in a point n', nearer to M than n is, which was the former place of her deſcending node. By this change of orbit, the line EX will no longer be perpendicular to it; but there will be another line Ex, which will now be perpendicular to the new orbit. Alſo the Moon, moving from M to r, does not move as if ſhe had come from the aſcending node N, but from a point N' lying beyond it; and the line of the nodes of the orbit in this new poſition is N' n'. Alſo the angle MN'm is leſs than the angle MNm.

Thus the nodes ſhift their places in a direction oppoſite to that of her motion, or move to the weſtward; the axis of the orbit changes its poſition, and the orbit itſelf changes its inclination to the ecliptic. Theſe momentary changes are different in different parts of the orbit, according to the poſition of the line of the nodes. Sometimes the inclination of the orbit is increaſed, and ſometimes the nodes move to the eaſtward. But, in general, the inclination increaſes from the time that the nodes are in the line of ſyzigee, till they get into quadrature, after which it diminiſhes till the nodes are again in ſyzigee. The nodes advance only while they are in the octants after the quadratures, and while the moon paſſes from quadrature to the node, and they recede in all other ſituations. Therefore the receſs exceeds the advance in every revolution of the moon round the earth, and, on the whole, they recede.

What has been ſaid of one Moon, would be true of each of a continued ring of Moons ſurrounding the Earth, and they would thus compoſe a flexible ring, which would never be flat, but waved, according to the difference (both in kind and degree) of the diſturbing forces acting on its different parts. But ſuppoſe theſe Moons to cohere, and to form a rigid and flat ring, nothing would remain in this ring but the exceſs of the contrary tendencies of its different parts. Its axis would be perpendicular to its plane, and its poſition in any moment will be the mean poſition of all the axes of the orbits of each part of the flexible ring; therefore the nodes of this rigid ring will continually recede, except when the plane of the ring paſſes through the Sun, that is, when the nodes are in ſyzigee; and (ſays Newton) the motion of theſe nodes will be the ſame with the mean motion of the nodes of the orbit of one Moon. The inclination of this ring to the ecliptic will be equal to the mean inclination of the Moon's orbit during any one revolution which has the ſame ſituation of the nodes. It will therefore be leaſt of all when the nodes are in quadrature, and will increaſe till they are in ſyzigee, and then diminiſh till they are again in quadrature.

Suppoſe this ring to contract in dimenſions, the diſturbing forces will diminiſh in the ſame proportion, and in this proportion will all their effects diminiſh. Suppoſe its motion of revolution to accelerate, or the time of a revolution to diminiſh; the linear effects of the diſturbing forces being as the ſquares of the times of their action, and their angular effects as the times, thoſe errors muſt diminiſh alſo on this account; and we can compute what thoſe errors will be for any diameter of the ring, and for any period of its revolution. We can tell, therefore, what would be the motion of the nodes, the change of inclination, and deviation of the axis, of a ring which would touch the ſurface of the earth, and revolve in 24 hours; nay, we can tell what theſe motions would be, ſhould this ring adhere to the earth. They muſt be much leſs than if the ring were detached; For the diſturbing forces of the ring muſt drag along with it the whole globe of the earth. The quantity of motion which the diſturbing forces would have produced in the ring alone, will now (ſays Newton) be produced in the whole maſs; and therefore the velocity muſt be as much leſs as the quantity of matter is greater: But ſtill all this can be computed.

Now there is ſuch a ring on the earth: for the earth is not a ſphere, but an elliptical ſpheroid. Sir Iſaac Newton therefore engaged in a compoſition of the effects of the diſturbing force, and has exhibited a moſt beautiful example of mathematical inveſtigation. He firſt aſſerts, that the earth *muſt* be an elliptical ſpheroid, whoſe polar axis is to its equatorial diameter as 229 to 230. Then he demonſtrates, that if the ſine of the inclination of the equator be called π, and if t be the number of days (ſidereal) in a year, the annual motion of a detached ring will be $360^\circ \times \frac{3\sqrt{1-\pi^2}}{4t}$. He then ſhows that the effect of the diſturbing force on this ring is to its effect on the matter of the ſame ring, diſtributed in the form of an elliptical ſtratum (but ſtill detached) as 5 to 2; therefore the motion of the nodes will be $360^\circ \times \frac{3\sqrt{1-\pi^2}}{10t}$, or 16′ 16″ 24‴ annually. He then proceeds to ſhow, that the quantity of motion in the ſphere is to that in an equatorial ring revolving in the ſame time, as the matter in the ſphere to the matter in the ring, and as three times the ſquare of a quadrantal arch to two ſquares of a diameter, jointly: Then he ſhows, that the quantity of matter in the terreſtrial ſphere is to that in the protuberant matter of the ſpheroid, as 52900 to 461 (ſuppoſing all homogeneous). From theſe premiſes it follows, that the motion of 16′ 16″ 24‴, muſt be diminiſhed in the ratio of 10717 to 100, which reduces it to 9″ 07‴ annually. And this (he ſays) is the preceſſion of the equinoxes, occaſioned by the action of the ſun; and the reſt of the $50\frac{1}{3}''$, which is the obſerved preceſſion, is owing to the action of the moon, nearly five times greater than that of the ſun. This appeared a great difficulty; for the phenomena of the tides ſhow that it *cannot* much exceed twice the ſun's force.

29 His determination of the form and dimenſions of the earth demonſtrated by M'Laurin.

Nothing can exceed the ingenuity of this proceſs. Juſtly does his celebrated and candid commentator, Daniel Bernoulli, ſay (in his Diſſertation on the Tides, which ſhared the prize of the French Academy with M'Laurin and Euler), that Newton ſaw through a veil what others could hardly diſcover with a microſcope in the light of the meridian ſun. His determination of the form and dimenſions of the earth, which is the foundation of the whole proceſs, is not offered as any thing better than a probable gueſs, *in re difficillima*; and it has been ſince demonſtrated with geometrical rigour by M'Laurin.

His next principle, that the motion of the nodes of the rigid ring is equal to the mean motion of the nodes of the moon, has been moſt critically diſcuſſed by the firſt mathematicians, as a thing which could neither be proved nor refuted. Friſius has at leaſt ſhown it to be a miſtake, and that the motion of the nodes of the ring is double the mean motion of the nodes of a ſingle moon; and that Newton's own principles ſhould have produced a preceſſion of $18\frac{1}{4}$ ſeconds annually, which removes the difficulty formerly mentioned.

His third aſſumption, that the quantity of motion of the ring muſt be ſhared with the included ſphere, was acquieſced in by all his commentators, till D'Alembert and Euler, in 1749, ſhowed that it was not the quantity of motion round an axis of rotation which remained the ſame, but the quantity of momentum or rotatory effort. The quantity of motion is the product of every particle by its velocity; that is, by its diſtance from the axis; while its momentum, or power of producing rotation, is as the ſquare of that diſtance, and is to be had by taking the ſum of each particle multiplied by the ſquare of its diſtance from the axis. Since the earth differs ſo little from a perfect ſphere, this makes no ſenſible difference in the reſult. It will increaſe Newton's preceſſion about three-fourths of a ſecond.

30 Examination of the phenomenon of preceſſion on mechanical principles.

We proceed now to the examination of this phenomenon upon the fundamental principles of mechanics.

Becauſe the mutual gravitation of the particles of matter in the ſolar ſyſtem is in the inverſe ratio of the ſquares of the diſtance, it follows, that the gravitations of the different parts of the earth to the ſun or to the moon are unequal. The nearer particles gravitate more than thoſe that are more remote.

Plate CCCCXIV.

Let PQ*p*E (fig. 3.), be a meridional ſection of the terreſtrial ſphere, and PO*pq* the ſection of the inſcribed ſphere. Let CS be a line in the plane of the ecliptic paſſing through the ſun, ſo that the angle ECS is the ſun's declination. Let NCM be a plane paſſing thro' the centre of the earth at right angles to the plane of the meridian PQ*p*E; NCM will therefore be the plane of illumination.

In conſequence of the unequal gravitation of the matter of the earth to the ſun, every particle, ſuch as B, is acted on by a diſturbing force parallel to CS, and proportional to BD, the diſtance of the particle from the plane of illumination; and this force is to the gravitation of the central particle to the ſun, as three times BD is to CS, the diſtance of the earth from the ſun.

Let AB*a* be a plane paſſing through the particle B, parallel to the plane EQ of the equator. This ſection of the earth will be a circle, of which A*a* is a diameter, and Q*q* will be the diameter of its ſection with the inſcribed ſphere. Theſe will be two concentric circles, and the ring by which the ſection of the ſpheroid exceeds the ſection of the ſphere will have AQ for its breadth; P*p* is the axis of figure.

Let

Let EC be repreſented by the ſymbol	a
OC or PC	b
EO their difference, $=\frac{a^2-b^2}{a+b}$	d
CL	x
QL	$\sqrt{b^2-x^2}$
The periphery of a circle to radius 1	Π
The diſturbing force at the diſtance 1 from the plane NCM	f
The ſine of declination ECS	m
The coſine of ECS	n

It is evident, that with reſpect to the inſcribed ſphere, the diſturbing forces are completely compenſated, for every particle has a correſponding particle in the adjoining quadrant, which is acted on by an equal and oppoſite force. But this is not the caſe with the protuberant matter which makes up the ſpheroid. The ſegments NS sn and MT tm are more acted on than the ſegments NT tn and MS sm; and thus there is produced a tendency to a converſion of the whole earth, round an axis paſſing through the centre C, perpendicular to the plane PQ p E. We ſhall diſtinguiſh this motion from all others to which the ſpheroid may be ſubject, by the name LIBRATION. The axis of this libration is always perpendicular to that diameter of the equator over which the ſun is, or to that meridian in which he is.

PROB. I. To determine the momentum of libration corresponding to any poſition of the earth reſpecting the ſun, that is, to determine the accumulated energy of the diſturbing forces on all the protuberant matter of the ſpheroid.

Let B and b be two particles in the ring formed by the revolution of AQ, and ſo ſituated, that they are at equal diſtances from the plane NM; but on oppoſite ſides of it. Draw BD, bd, perpendicular to NM, and FLG perpendicular to LT.

Then, becauſe the momentum, or power of producing rotation, is as the force and as the diſtance of its line of direction from the axis of rotation, jointly, the combined momentum of the particles B and b will be $f.\,\mathrm{BD.DC}-f.bd.dc$, (for the particles B and b, are urged in contrary directions). But the momentum of B is $f.\,\mathrm{BF.DC}+f.\mathrm{FD.DC}$, and that of b is $f.\,b\mathrm{G}.d\mathrm{C}-f.d\mathrm{G}.d\mathrm{C}$; and the combined momentum is $f.\,\mathrm{BF.D}d-f.\mathrm{FD}.\overline{\mathrm{DC}+d\mathrm{C}},=2f.\mathrm{BF.LF}-2f.\mathrm{LT.TC}$.

Becauſe m and n are the ſine and coſine of the angle ECS or LCT, we have $\mathrm{LT}=m.\mathrm{CL}$, and $\mathrm{CT}=n.\,\mathrm{CL}$, and $\mathrm{LF}=m.\mathrm{BL}$, and $\mathrm{BF}=n.\,\mathrm{BL}$. This gives the momentum $=2fmn\,\overline{\mathrm{BL}^2-\mathrm{CL}^2}$.

The breadth AQ of the protuberant ring being very ſmall we may ſuppoſe, without any ſenſible error, that all the matter of the line AQ is collected in the point Q; and, in like manner, that the matter of the whole ring is collected in the circumference of its inner circle, and that B and b now repreſent, not ſingle particles, but the collected matter of lines ſuch as AQ, which terminate at B and b. The combined momentum of two ſuch lines will therefore be $2\,m\,n\,f.\mathrm{AQ}.\overline{\mathrm{BL}^2-\mathrm{CL}^2}$.

Let the circumference of each parallel of latitude be divided into a great number of indefinitely ſmall and equal parts. The number of ſuch parts in the circumference, of which Q q is the diameter, will be $\Pi\cdot\mathrm{QL}$. To each pair of theſe there belongs a momentum $2\,mnf.\mathrm{AQ}\cdot\overline{\mathrm{BL}^2-\mathrm{CL}^2}$. The ſum of all the ſquares of BL, which can be taken round the circle, is one half of as many ſquares of the radius CL: for BL is the ſine of an arch, and the ſum of its ſquare and the ſquare of its correſponding coſine is equal to the ſquare of the radius. Therefore the ſum of all the ſquares of the ſines, together with the ſum of all the ſquares of the coſines is equal to the ſum of the ſame number of ſquares of the radius; and the ſum of the ſquares of the ſines is equal to the ſum of the ſquares of the correſponding coſines: therefore the ſum of the ſquares of the radius is double of either ſum. Therefore $\int\Pi.\mathrm{QL}\cdot\mathrm{BL}^2=\frac{1}{2}\Pi\cdot\mathrm{QL.QL}^2$. In like manner the ſum of the number $\Pi.\mathrm{QL}$ of CL^2s will be $=\Pi.\mathrm{QL.CL}^2$. Theſe ſums, taken for the ſemicircle, are $\frac{1}{4}\Pi.\mathrm{QL.QL}^2$, and $\frac{1}{2}\Pi\cdot\mathrm{QL.CL}^2$, or $\Pi\cdot\mathrm{QL}\cdot\frac{1}{4}\mathrm{QL}^2$, and $\Pi\cdot\mathrm{QL}\cdot\frac{1}{2}\mathrm{CL}^2$: therefore the momentum of the whole ring will be $2\,m\,n\,f\cdot\mathrm{AQ\,QL}.\Pi\,(\frac{1}{4}\mathrm{QL}^2-\frac{1}{2}\mathrm{CL}^2)$: for the momentum of the ring is the combined momenta of a number of pairs, and this number is $\frac{1}{2}\Pi\cdot\mathrm{QL}$.

By the ellipſe we have $\mathrm{OC}:\mathrm{QL}=\mathrm{EO}:\mathrm{AQ}$, and $\mathrm{AQ}=\mathrm{QL}\frac{\mathrm{EO}}{\mathrm{OC}},=\mathrm{QL}\frac{d}{b}$; therefore the momentum of the ring is $2\,m\,n\,f\frac{d}{b}\mathrm{QL}^2\Pi\,(\frac{1}{4}\mathrm{QL}^2-\frac{1}{2}\mathrm{CL}^2),=m\,n\,f\frac{d}{b}\mathrm{QL}^2\Pi\,(\frac{1}{2}\mathrm{QL}^2-\mathrm{CL}^2)$: but $\mathrm{QL}^2=b^2-x^2$; therefore $\frac{1}{2}\mathrm{QL}^2-\mathrm{CL}^2=\frac{1}{2}b^2-\frac{1}{2}x^2-x^2,=\frac{1}{2}b^2-\frac{3}{2}x^2,=\frac{b^2-3x^2}{2}$; therefore the momentum of the ring is $m\,n\,f\frac{d}{b}\Pi(b^2-x^2)\left(\frac{b^2-3x^2}{2}\right)=m\,n\,f\frac{d}{b}\Pi\left(\frac{b^4-4b^2x^2+3x^4}{2}\right),=m\,n\,f\frac{d}{2b}\Pi\,(b^4-4b^2x^2+3x^4)$. If we now ſuppoſe another parallel extremely near to Aa, as repreſented by the dotted line, the diſtance Ll between them being $\dot{x}$, we ſhall have the fluction of the momentum of the ſpheroid $mnf\frac{d}{2b}\Pi\,(b^4\dot{x}-4b^2x^2\dot{x}+3x^4\dot{x})$, of which the fluent is $m\,n\,f\frac{d}{2b}\Pi\left(b^4x-4b^2\frac{x^3}{3}+\frac{3x^5}{5}\right)$. This expreſſes the momentum of the zone EA aQ, contained between the equator and the parallel of latitude A a. Now let x become $=b$, and we ſhall obtain the momentum of the hemiſpheroid $=m\,n\,f\frac{d}{2b}\Pi\,(b^5-\frac{4}{3}b^5+\frac{3}{5}b^5)$, and that of the ſpheroid $=m\,n\,f\frac{d}{b}\Pi\,(b^5-\frac{4}{3}b^5+\frac{3}{5}b^5)=\frac{4}{15}\,m\,n\,f\,d\,\Pi\,b^4$.

This formula does not expreſs any motion, but only a preſſure tending to produce motion, and particularly tending to produce a libration by its action on the cohering matter of the earth, which is affected as a number of levers. It is ſimilar to the common mechanical formula $w.d$, where w means a weight, and d its diſtance from the fulcrum of the lever.

It is worthy of remark, that the momentum of this protuberant matter is juſt $\frac{2}{5}$ of what it would be if it were all collected at the point O of the equator: for the matter in the ſpheroid is to that in the inſcribed ſphere as a^2 to b^2, and the contents of the inſcribed ſphere is $\frac{2}{3}\,\Pi\,b^3$. Therefore $a^2:a^2-b^2=\frac{2}{3}\Pi b^3:\frac{2}{3}\Pi b^3\frac{a^2-b^2}{a^2}$, which is the quantity of protuberant matter. We may, without ſenſible error, ſuppoſe $\frac{a^2-b^2}{a}=2d$,

$= 2d$; then the protuberant matter will be $\frac{4}{3}\Pi b^2 d$. If all this were placed at O, the momentum would be $\frac{4}{3}\Pi db^2 f \cdot \mathrm{OH} \cdot \mathrm{HC}, = \frac{4}{3} mnfdb^4$, becauſe $\mathrm{OH} \cdot \mathrm{HC} = mnb^2$; now $\frac{4}{3}$ is 5 times $\frac{4}{15}$.

Alſo, becauſe the ſum of all the rectangles OH·HC round the equator is half of as many ſquares of OC, it follows that the momentum of the protuberant matter placed in a ring round the equator of the ſphere or ſpheroid is one half of what it would be if collected in the point O or E; whence it follows that the momentum of the protuberant matter in its natural place is two fifths of what it would be if it were diſpoſed in an equatorial ring. It was in this manner that Sir Iſaac Newton was enabled to compare the effect of the ſun's action on the protuberant matter of the earth, with his effect on a rigid ring of moons. The preceding inveſtigation of the momentum is nearly the ſame with his, and appears to us greatly preferable in point of perſpicuity to the fluxionary-ſolutions given by later authors. Theſe indeed have the appearance of greater accuracy, becauſe they do not ſuppoſe all the protuberant matter to be condenſed on the ſurface of the inſcribed ſphere: nor were we under the neceſſity of doing this, only it would have led to very complicated expreſſions had we ſuppoſed the matter in each line AQ collected in its centre of oſcillation or gyration. We made a compenſation for the error introduced by this, which may amount to $\frac{1}{115}$ of the whole, and ſhould not be neglected, by taking d as equal to $\frac{a^2 - b^2}{2a}$. inſtead of $\frac{a^2 - b^2}{a \times b}$. The conſequence is, that our formula is the ſame with that of the later authors.

Thus far Sir Iſaac Newton proceeded with mathematical rigour; but in the application he made two aſſumptions, or, as he calls them, hypotheſes, which have been found to be unwarranted. The firſt was, that when the ring of protuberant matter is connected with the inſcribed ſphere, and ſubjected to the action of the diſturbing force, the ſame quantity of motion is produced in the whole maſs as in the ring alone. The ſecond was, that the motion of the nodes of a rigid ring of moons is the ſame with the mean motion of the nodes of a ſolitary moon. But we are now able to demonſtrate, that it is not the quantity of motion, but of momentum, which remains the ſame, and that the nodes of a rigid ring move twice as faſt as thoſe of a ſingle particle. We proceed therefore to

31
Effects of the libratory momentum of the earth's protuberant matter.

Prob. 2. To determine the deviation of the axis, and the retrograde motion of the nodes which reſult from this libratory momentum of the earth's protuberant matter.

But here we muſt refer our readers to ſome fundamental propoſitions of rotatory motions which are demonſtrated in the article Rotation.

If a rigid body is turning round an axis A, paſſing through its centre of gravity with the angular velocity a, and receives an impulſe which alone would cauſe it to turn round an axis B, alſo paſſing through its centre of gravity, with the angular velocity b, the body will now turn round a third axis C, paſſing thro' its centre of gravity, and lying in the plane of the axes A and B, and the ſine of the inclination of this third axis to the axis A will be to the ſine of inclination to the axis B as the velocity b to the velocity a.

32 When a rigid body is made to turn round any axis by the action of an external force, the quantity of momentum produced that is, the ſum of the products of every particle by its velocity and by its diſtance from the axis) is equal to the momentum or ſimilar product of the moving force or forces.

33 If an oblate ſpheroid, whoſe equatorial diameter is a and polar diameter b, be made to librate round an equatorial diameter, and the velocity of that point of the equator which is fartheſt from the axis of libration be v, the momentum of the ſpheroid is $\frac{4}{15}\Pi a^2 b^2 v$.

The two laſt are to be found in every elementary book of mechanics.

Plate CCCCXIV.

Let ANan (fig. 4.) be the plane of the earth's equator, cutting the ecliptic CNKn in the line of the nodes or equinoctial points Nn. Let OAS be the ſection of the earth by a meridian paſſing through the ſun, ſo that the line OCS is in the ecliptic, and CA is an arch of an hour-circle or meridian, meaſuring the ſun's declination. The ſun not being in the plane of the equator, there is, by prop. 1. a force tending to produce a libration round an axis ZOz at right angles to the diameter Aa of that meridian in which the ſun is ſituated, and the momentum of all the diſturbing forces is $\frac{4}{15} mnf\Pi db^4$. The product of any force by the moment $\dot{t}$ of its action expreſſes the momentary increment of volocity; therefore the momentary velocity, or the velocity of libration generated in the time $\dot{t}$ is $\frac{4}{15} mnfd\Pi b^4 \dot{t}$. This is the abſolute velocity of a point at the diſtance 1 from the axis, or it is the ſpace which would be uniformly deſcribed in the moment $\dot{t}$, with the velocity which the point has acquired at the end of that moment. It is double the ſpace actually deſcribed by the libration during that moment; becauſe this has been an uniformly accelerated motion, in conſequence of the continued and uniform action of the momentum during this time. This muſt be carefully attended to, and the neglect of it has occaſioned very faulty ſolutions of this problem.

Let v be the velocity produced in the point A, the moſt remote from the axis of libration. The momentum excited or produced in the ſpheroid is $\frac{4}{15}\Pi a^2 b^2 v$ (as above), and this muſt be equal to the momentum of the moving force, or to $\frac{4}{15} mnfd\Pi b^4 \dot{t}$; therefore we obtain $v = \frac{\frac{4}{15} mnfd\Pi b^4 t}{\frac{4}{15}\Pi a^2 b^2}$, that is, $v = mnfd\dot{t}\frac{b^2}{a^2}$ or very nearly $mnfd\dot{t}$, becauſe $\frac{b^2}{a^2} = 1$ very nearly. Alſo, becauſe the product of the velocity and time gives the ſpace uniformly deſcribed in that time, the ſpace deſcribed by A in its libration round Zz is $mnfd\dot{t}^2$, and the angular velocity is $\frac{mnfd\dot{t}}{a}$.

Let $\dot{r}$ be the momentary angle of diurnal rotation. The arch Ar, deſcribed by the point A of the equator in this moment $\dot{t}$ will therefore be $a\dot{r}$, that is, $a \times \dot{r}$, and the velocity of the point A is $\frac{a\dot{r}}{\dot{t}}$. and the angular velocity of rotation is $\frac{\dot{r}}{\dot{t}}$.

Here then is a body (fig. 5.) turning round an axis OP, perpendicular to the plane of the equator zoz, and therefore ſituated in the plane ZPz; and it turns round this axis with the angular velocity $\frac{\dot{r}}{\dot{t}}$. It has received an impulſe, by which alone it would librate round the axis Z*z*, with the angular velocity $\frac{mnfd\dot{t}}{a}$. It will therefore turn round neither axis (n° 31.), but round a third axis OP′, paſſing through O, and lying in the plane ZP*z*, in which the other two are ſituated, and the ſine P′π of its inclination to the axis of libration Z*z* will be to the ſine P′*p* of its inclination to the axis OP of rotation as $\frac{\dot{r}}{\dot{t}}$ to $\frac{mnfd\dot{t}}{a}$

Now A, in fig. 4. is the ſummit of the equator both of libration and rotation; $mnfd\dot{t}^2$ is the ſpace deſcribed by its libration in the time $\dot{t}$; and $a\dot{r}$ is the ſpace or arch A*r* (fig. 4.) deſcribed in the ſame time by its rotation: therefore, taking A*r* to A*c* (perpendicular to the plane of the equator of rotation, and lying in the equator of libration), as $a\dot{r}$ to $mnfd\dot{t}^2$, and completing the parallelogram A*rmc*, A*m* will be the compound motion of A (n° 31.), and $a\dot{r} : mndf\dot{t}^2 = 1 : \frac{mnfd\dot{t}^2}{a\dot{r}}$, which will be the tangent of the angle *m*A*r*, or of the change of poſition of the equator. But the axes of rotation are perpendicular to their equator; and therefore the angle of deviation $\dot{w}$ is equal to this angle *r*A*m*. This appears from fig. 5.; for πP : P′*p*=O*p* : P′*p*,=OP : tan. POP; and it is evident that $a\dot{r} : mnfd\dot{t}^2 = \frac{\dot{r}}{\dot{t}} : mnfd\frac{\dot{t}}{a}$, as is required by the compoſition of rotations.

In conſequence of this change of poſition, the plane of the equator no longer cuts the plane of the ecliptic in the line N*n*. The plane of the new equator cuts the former equator in the line AO, and the part AN of the former equator lies between the ecliptic and the new equator AN′, while the part A*n* of the former equator is above the new one A*n′*; therefore the new node N′, from which the point A was moving, is removed to the weſtward, or farther from A; and the new node *n′*, to which A is approaching, is alſo moved weſtward, or nearer to A; and this happens in every poſition of A. The nodes, therefore, or equinoctial points, continually ſhift to the weſtward, or in a contrary direction to the rotation of the earth; and the axis of rotation always deviates to the eaſt ſide of the meridian which paſſes through the ſun.

This account of the motions is extremely different from what a perſon ſhould naturally expect. If the earth were placed in the ſummer ſolſtice, with reſpect to us who inhabit its northern hemiſphere, and had no rotation round its axis, the equator would begin to approach the ecliptic, and the axis would become more upright; and this would go on with a motion continually accelerating, till the equator coincided with the ecliptic. It would not ſtop here, but go as far on the other ſide, till its motion were extinguiſhed by the oppoſing forces; and it would return to its former poſition, and again begin to approach the ecliptic, playing up and down like the arm of a balance. On this account this motion is very properly termed *libration;* but this very ſlow libration, compounded with the incomparably ſwifter motion of diurnal rotation, produces a third motion extremely different from both. At firſt the north pole of the earth inclines forward toward the ſun; after a long courſe of years it will incline to the left hand, as viewed from the ſun, and be much more inclined to the ecliptic, and the plane of the equator will paſs through the ſun. Then the ſouth pole will come into view, and the north pole will begin to decline from the ſun; and this will go on (the inclination of the equator diminiſhing all the while) till, after a courſe of years, the north pole will be turned quite away from the ſun, and the inclination of the equator will be reſtored to its original quantity. After this the phenomena will have another period ſimilar to the former, but the axis will now deviate to the right hand. And thus, although both the earth and ſun ſhould not move from their places, the inhabitants of the earth would have a complete ſucceſſion of the ſeaſons accompliſhed in a period of many centuries. This would be prettily illuſtrated by an iron ring poiſed very nicely on a cap like the card of a mariner's compaſs, having its centre of gravity coinciding with the point of the cap, ſo that it may whirl round in any poſition. As this is extremely difficult to execute, the cap may be pierced a little deeper, which will cauſe the ring to maintain a horizontal poſition with a very ſmall force. When the ring is whirling very ſteadily, and pretty briſkly, in the direction of the hours of a watch-dial, hold a ſtrong magnet above the middle of the nearer ſemicircle (above the 6 hour point) at the diſtance of three or four inches. We ſhall immediately obſerve the ring riſe from the 9 hour point, and ſink at the 3 hour point, and gradually acquire a motion of preceſſion and nutation, ſuch as has been deſcribed.

If the earth be now put in motion round the ſun, or the ſun round the earth, motions of libration and deviation will ſtill obtain, and the ſucceſſion of their different phaſes, if we may ſo call them, will be perfectly analogous to the above ſtatement. But the quantity of deviation, and change of inclination, will now be prodigiouſly diminiſhed, becauſe the rapid change of the ſun's poſition quickly diminiſhes the diſturbing forces, annihilates them by bringing the ſun into the plane of the equator, and brings oppoſite forces into action.

We ſee in general that the deviation of the axis is always at right angles to the plane paſſing through the ſun, and that the axis, inſtead of being raiſed from the ecliptic, or brought nearer to it, as the libration would occaſion, deviates ſidewiſe; and the equator, inſtead of being raiſed or depreſſed round its eaſt and weſt points, is twiſted ſidewiſe round the north and ſouth points; or at leaſt things have this appearance: but we muſt now attend to this circumſtance more minutely.

The compoſition of rotation ſhows us that this change of the axis of diurnal rotation is by no means a tranſlation of the former axis (which we may ſuppoſe to be the axis of figure) into a new poſition, in which it again becomes the axis of diurnal motion; nor does the equator of figure, that is, the moſt prominent ſection of the terreſtrial ſpheroid, change its poſition, and in this new poſition continue to be the equator of rotation. This was indeed ſuppoſed by Sir Iſaac Newton; and this ſuppoſition naturally reſulted from the train of reaſoning which he adopted. It was ſtrictly true of a ſingle moon, or of the imaginary orbit attached to it; and therefore Newton ſuppoſed that the whole earth did in this manner deviate from its former poſition, ſtill, however, turning round its axis of figure. In this he has been followed by Walmeſly, Simpſon, and moſt of his commentators. D'Alembert was the firſt who entertained any ſuſpicion that this might not be certain; and both he and Euler at laſt ſhowed that the new axis of rotation was really a new line in the body of the earth, and that its axis and equator of figure did not remain the axis and equator of rotation. They aſcertained the poſition of the real axis by means of a moſt intricate analyſis, which obſcured the connection of the different poſitions of the axis with each other, and gave us only a kind of momentary information. Father Friſius turned his thoughts to this problem, and fortunately diſcovered the compoſition of rotations as a general principle of mechanical philoſophy. Few things of this kind have eſcaped the penetrating eye of Sir Iſaac Newton. Even *this* principle had been glanced at by him. He affirms it in expreſs terms with reſpect to a body that is perfectly ſpherical (cor. 22. prop. 66. B. I.) But it was reſerved for Friſius to demonſtrate it to be true of bodies of any figure, and thus to enrich mechanical ſcience with a principle which gives ſimple and elegant ſolutions of the moſt difficult problems.

But here a very formidable objection naturally offers itſelf. If the axis of the diurnal motion of the heavens is not the axis of the earth's ſpheroidal figure, but an imaginary line in it, round which even the axis of figure muſt revolve; and if this axis of diurnal rotation has ſo greatly changed its poſition, that it now points at a ſtar at leaſt 12 degrees diſtant from the pole obſerved by Timochares, how comes it that the equator has the very ſame ſituation on the ſurface of the earth that it had in ancient times? No ſenſible change has been obſerved in the latitudes of places.

The anſwer is very ſimple and ſatisfactory: Suppoſe that in 12 hours the axis of rotation has changed from the poſition PR (fig. 6.) to pr, ſo that the north pole, inſtead of being at P, which we may ſuppoſe to be a particular mountain, is now at p. In this 12 hours the mountain P, by its rotation round pr, has acquired the poſition π. At the end of the next 12 hours, the axis of rotation has got the poſition $\pi\rho$, and the axis of figure has got the poſition pr, and the mountain P is now at p. Thus, on the noon of the following day, the axis of figure PR is in the ſituation which the real axis of rotation occupied at the intervening midnight. This goes on continually, and the axis of figure follows the poſition of the axis of rotation, and is never further removed from it than the deviation of 12 hours, which does not exceed $\frac{1}{700}$th part of one ſecond, a quantity altogether imperceptible. Therefore the axis of figure will always ſenſibly coincide with the axis of rotation, and no change can be procured in the latitudes of places on the ſurface of the earth. Plate CCCCXIV

34 Application of this reaſoning to nutation and preceſſion.

We have hitherto conſidered this problem in the moſt general manner; let us now apply the knowledge we have gotten of the deviation of the axis or of the momentary action of the diſturbing force to the explanation of the phenomena: that is, let us ſee what preceſſion and what nutation will be accumulated after any given time of action.

For this purpoſe we muſt aſcertain the preciſe deviation which the diſturbing forces are competent to produce. This we can do by comparing the momentum of libration with the gravitation of the earth to the ſun, and this with the force which would retain a body on the equator while the earth turns round its axis.

The gravitation of the earth to the ſun is in the proportion of the ſun's quantity of matter M directly, and to the ſquare of the diſtance A inverſely, and may therefore be expreſſed by the ſymbol $\frac{M}{A^2}$. The diſturbing force at the diſtance 1 from the plane of illumination is to the gravitation of the earth's centre to the ſun as 3 to A, (A being meaſured on the ſame ſcale which meaſures the diſtance from the plane of illumination). Therefore $\frac{3M}{A^3}$ will be the diſturbing force f of our formula.

Let p be the centrifugal force of a particle at the diſtance 1 from the axis of rotation; and let t and T be the times of rotation and of annual revolution, viz. ſidereal day and year. Then $p : \frac{M}{A^2} = \frac{1}{t^2} : \frac{A}{T^2}$. Hence we derive $\frac{3M}{A^3} = 3p\frac{t^2}{T^2}$. But ſince $\dot{r}$ was the angular velocity of rotation, and conſequently $1 \times \dot{r}$ the ſpace deſcribed, and $\frac{1 \times \dot{r}}{\dot{t}}$ the velocity; and ſince the centrifugal force is as the ſquare of the velocity divided by the radius, (this being the meaſure of the generated velocity, which is the proper meaſure of any accelerating force), we have $p = \frac{1^2 \times \dot{r}^2}{1^2 \times \dot{t}^2}, = \frac{\dot{r}^2}{\dot{t}^2}$, and $f = \frac{3\dot{r}^2}{\dot{t}^2} \times \frac{\dot{t}^2}{T^2}$. Now the formula $f\,m\,n\,d\frac{\dot{t}^2}{a}$ expreſſed the ſine of the angle. This being extremely ſmall, the ſine may be conſidered as equal to the arc which meaſures the angle. Now, ſubſtitute for it the value now found, viz. $\frac{3\dot{r}^2}{\dot{t}^2} \times \frac{\dot{t}^2}{T^2}$, and we obtain the angle of deviation $\dot{w} = \dot{r}\frac{3t^2}{T^2}mn\frac{d}{a}$, and this is the ſimpleſt form in which it can appear. But it is convenient, for other reaſons, to expreſs it a little differently: d is nearly equal to $\frac{a^2 - b^2}{2a^2}$, therefore $\dot{w} = \dot{r} \times \frac{3}{2}\frac{t^2}{T^2}mn\frac{a^2 - b^2}{a^2}$, and this is the form in which we ſhall now employ it.

The ſmall angle $\dot{r}\frac{3t^2}{2T^2}mn\frac{a^2 - b^2}{a^2}$ is the angle in which the new equator cuts the former one. It is different at different times, as appears from the variable part mn, the product of the ſine and coſine of the ſun's declination. It will be a maximum when the declination is in the ſolſtice, for mn increaſes all the way to 45°, and the declination never exceeds 23½. It increaſes, therefore, from the equinox to the ſolſtice, and then diminiſhes.

Let ESL (fig. 7.) be the ecliptic, EAC the equator, BAD the new poſition which it acquires by the momentary action of the ſun, cutting the former in the angle BAE $= \dot{r}\frac{3}{2}\frac{t^2}{T^2}mn\frac{a^2 - b^2}{a^2}$. Let S be the ſun's place in the ecliptic, and AS the ſun's declination, the meridian AS being perpendicular to the equator. Let $\frac{a^2 - b^2}{a^2}$ be k. The angle BAE is then $= \dot{r}\frac{3t^2}{2T^2}kmn$. In the ſpherical triangle BAE we have ſin. B : ſin. AE = ſin. A : ſin. BE, or = A : BE, becauſe very ſmall angles and arches are as their ſines. Therefore BE, which is the momentary preceſſion of the equinoctial point E, is equal to A $\frac{\text{ſin. AE}}{\text{ſin. B}}$, $= \dot{r} \times \frac{3t^2}{2T^2}k\ m\ n$, $\frac{\text{ſin. R. aſcenſ.}}{\text{ſin. obl. ecl.}}$.

35 Various modes of application.

The equator EAC, by taking the poſition BAD, recedes from the ecliptic in the colure of the ſolſtices CL, and CD is the change of obliquity or the nutation. For let CL be the ſolſtitial colure of BAD, and $c\ l$ the ſolſtitial colure of EAC. Then we have ſin. B : ſin. E = ſin. LD : ſin. $l\,c$; and therefore the difference of the arches LD and $l\,c$ will be the meaſure of the difference of the angles B and E. But when BE is indefinitely ſmall, CD may be taken for the difference of LD and $l\,c$, they being ultimately in the ratio of equality. Therefore CD meaſures the change of the obliquity of the ecliptic, or the nutation of the axis with reſpect to the ecliptic.

The real deviation of the axis is the ſame with the change in the poſition of the equator, P p being the meaſure of the angle EAB. But this not being always made in a plane perpendicular to the ecliptic, the change of obliquity generally differs from the change in the poſition of the axis. Thus when the ſun is in the ſolſtice, the momentary change of the poſition of the equator is the greateſt poſſible; but being made at right angles to the plane in which the obliquity of the ecliptic is computed, it makes no change whatever in the obliquity, but the greateſt poſſible change in the preceſſion.

36 In order to find CD the change of obliquity, obſerve that in the triangle CAD, R : ſin. AC, or R : coſ. AE = ſin. A : ſin. CD, = A : CD (becauſe A and CD are exceedingly ſmall). Therefore the change of obliquity (which is the thing commonly meant by nutation) CD = A × coſ. AE, $= \dot{r}\frac{3t^2}{2T^2}kmn$, coſ. AE $= \dot{r}\frac{3t^2}{2T^2}$ $k \times$ ſin. declin. × coſ. declin. × coſ. R. aſcenſ.

37 But it is more convenient for the purpoſes of aſtronomical computation to make uſe of the ſun's longitude SE. Therefore make

The ſun's longitude ES - - = z
Sine of ſun's long. - - = x
Coſine - - - $\sqrt{1-x^2}$ = y
Sine obliq. eclipt. - - $23\frac{1}{2}$ = p
Coſine obliq. - - - - = q

38 In the ſpherical triangle EAS, right angled at A (becauſe AS is the ſun's declination perpendicular to the equator), we have R : ſin. ES = ſin. E : ſin. AS, and ſin. AS = $p\,x$. Alſo R : coſ. AS = coſ. AE : coſ. ES, and coſ. ES or y = coſ. AS × coſ. AE. Therefore pxy = ſin. AS × coſ. AS × coſ. AE, = mn × coſ. AE. Therefore the momentary nutation CD $= \dot{r} \times \frac{3t^2}{2T^2}kpxy$.

39 We muſt recollect that this angle is a certain fraction of the momentary diurnal rotation. It is more convenient to conſider it as a fraction of the ſun's annual motion, that ſo we may directly compare his motion on the ecliptic with the preceſſion and nutation correſponding to his ſituation in the heavens. This change is eaſily made, by augmenting the fraction in the ratio of the ſun's angular motion to the motion of rotation, or multiplying the fraction by $\frac{T}{t}$; therefore the momentary nutation will be $\dot{r}\frac{t\,3}{2T}k\,p\,x\,y$. In this value $\frac{3tkp}{2T}$ is a conſtant quantity, and the momentary nutation is proportional to $x\,y$, or to the product of the ſine and coſine of the ſun's longitude, or to the ſine of twice the ſun's longitude; for $x\,y$ is equal to half the ſine of twice z.

40 If therefore we multiply this fraction by the ſun's momentary angular motion, which we may ſuppoſe, with abundant accuracy, proportional to $\dot{z}$, we obtain the fluxion of the nutation, the fluent of which will expreſs the whole nutation while the ſun deſcribes the arch z of the ecliptic, beginning at the vernal equinox. Therefore, in place of y put $\sqrt{1-x^2}$, and in place of $\dot{z}$ put $\frac{\dot{x}}{\sqrt{1-x^2}}$, and we have the fluxion of the nutation for the moment when the ſun's longitude is z and the fluent will be the whole nutation. The fluxion reſulting from this proceſs is $\frac{3tkp}{2T}x\,\dot{x}$, of which the fluent is $\frac{3tkp}{4T}x^2$. This is the whole change produced on the obliquity of the ecliptic while the ſun moves along the arch z ecliptic, reckoned from the vernal equinox. When this arch is 90°, x^2 is 1, and therefore $\frac{3tkp}{4T}$ is the nutation produced while the ſun moves from the equinox to the ſolſtice.

The momentary change of the axis and plane of the equator (which is the meaſure of the changing force) is $\frac{3tk}{2T}mn$.

41 The real and momentary changes greateſt at the ſolſtices and at the equinoxes, nothing.

The momentary change of the obliquity of the ecliptic is $\frac{3tkp}{2T}x\,\dot{x}$

The whole change of obliquity is $\frac{3tkp}{4T}x^2$.

Hence we ſee that the force and the real momentary change of poſition are greateſt at the ſolſtices, and diminiſh to nothing in the equinoxes.

The momentary change of obliquity is greateſt at the octants, being proportional to $x\,\dot{x}$ or to $x\,y$.

The whole accumulated change of obliquity is greateſt at the ſolſtices, the obliquity itſelf being then ſmalleſt.

42 Quantity of preceſſion in a given time.

We muſt in like manner find the accumulated quantity of the preceſſion after a given time, that is, the arch BE for a finite time.

We have ER : CD = ſin. EA : ſin. CA (or coſ. EA) = tan. EA : 1, and EB : ER = 1 : ſin. B. Therefore EB : CD = tan. EA : ſin. B. But tan. EA = coſ. E × tan. ES, = coſ. E × $\frac{\text{ſin. long.}}{\text{coſ. long.}} = \frac{q\ x}{\sqrt{1-x^2}}$. Therefore EB : CD $= \frac{q\,x}{\sqrt{1-x^2}\,p}$, and CD = EB : $\frac{\text{ſin. obliq. eclip.}}{\text{tan. long. ☉}}$. If we now ſubſtitute for CD its value found in nº 40. viz. $\frac{3tkp}{2T}x\,\dot{x}$, we obtain EB $= \frac{3t}{2T} \times \frac{k\,q\,x^2\dot{x}}{\sqrt{1-x^2}}$, the fluxion of the preceſſion of the equinoxes occaſioned by the action of the ſun. The fluent of the variable part $\frac{x^2\dot{x}}{\sqrt{1-x^2}} = x\dot{y}$, of which the fluent is evidently a ſegment of a circle whoſe arch is z and ſine x, that is, $= \frac{z-x\sqrt{1-x^2}}{2}$, and the whole preceſſion, while the ſun deſcribes the arch z, is $\frac{3t}{2T} \times \frac{kq}{2}\left(z-x\sqrt{1-x^2}.\right)$ This is the preceſſion of the equinoxes while the ſun moves from the vernal equinox along the arch z of the ecliptic.

In this expreſſion, which conſiſts of two parts, $\frac{3tkq}{4T}z$, and $\frac{3tkq}{4T}\left(-x\sqrt{1-x^2}\right)$, the firſt is incomparably greater than the ſecond, which never exceeds 1'', and is always compenſated in the ſucceeding quadrant. The preceſſion occaſioned by the ſun will be $\frac{3tkq}{4T}z$, and from this expreſſion we ſee that the preceſſion increaſes uniformly, or at leaſt increaſes at the ſame rate with the ſun's longitude z, becauſe the quantity $\frac{3tkq.}{4T}$ is conſtant.

43
Mode of uſing the formulæ.

In order to make uſe of theſe formulæ, which are now reduced to very great ſimplicity, it is neceſſary to determine the values of the two conſtant quantities $\frac{3tkp}{4T}$, $\frac{3tkq}{4T}$, which we ſhall call N and P, as factors of the nutation and preceſſion. Now t is one ſidereal day, and T is 366¼. k is $\frac{a^2-b^2}{a^2}$, which according to Sir Iſaac Newton is $\frac{231^2-230^2}{231^2}, = \frac{1}{115}$; p and q are the ſine and coſine of 23° 28', viz. 0,39822 and 0,91729.

Theſe data give $N = \frac{1}{141030}$ and $P = \frac{1}{61224}$ of which the logarithms are 4.85069 and 5.21308, viz. the arithmetical complements of 5.14931 and 4.78692.

44
Example of the utility of the inveſtigation.

Let us, for an example of the uſe of this inveſtigation, compute the preceſſion of the equinoxes when the ſun has moved from the vernal equinox to the ſummer ſolſtice, ſo that z is 90°, or 324000''.

Log 324000''=z - -	5.51055
Log P - - - -	5.21308
Log 5'',292 - - -	0.72363

The preceſſion therefore in a quarter of a year is 5,292 ſeconds; and, ſince it increaſes uniformly, it is 21'',168 annually.

45
Aſſumptions on which the computation proceeds.

We muſt now recollect the aſſumptions on which this computation proceeds. The earth is ſuppoſed to be homogeneous, and the ratio of its equatorial diameter to its polar axis is ſuppoſed to be that of 231 to 230. If the earth be more or leſs protuberant at the equator, the preceſſion will be greater or leſs in the ratio of this protuberance. The meaſures which have been taken of the degrees of the meridian are very inconſiſtent among themſelves; and although a compariſon of them all indicates a ſmaller protuberancy, nearly $\frac{1}{311}$ inſtead of $\frac{1}{231}$, their differences are too great to leave much confidence in this method. But if this figure be thought more probable, the preceſſion will be reduced to about 17'' annually. But even though the figure of the earth were accurately determined, we have no authority to ſay that it is hemogeneous. If it be denſer towards the centre, the momentum of the protuberant matter will not be ſo great as if it were equally denſe with the inferior parts, and the preceſſion will be diminiſhed on this account. Did we know the proportion of the matter in the moon to that in the ſun, we could eaſily determine the proportion of the whole obſerved annual preceſſion of 50⅓'' which is produced by the ſun's action. But we have no unexceptionable data for determining this; and we are rather obliged to infer it from the effect which ſhe produces in diſturbing the regularity of the preceſſion, as will be conſidered immediately. So far, therefore, as we have yet proceeded in this inveſtigation, the reſult is very uncertain. We have only aſcertained unqueſtionably the law which is obſerved in the ſolar preceſſion. It is probable, however, that this preceſſion is not very different from 20'' annually; for the phenomena of the tides ſhow the diſturbing force of the ſun to be very nearly ⅖ of the diſturbing force of the moon. Now 20'' is ⅖ of 50''.

46
Effect of the moon's action on the protuberant matter of the earth.

But let us now proceed to conſider the effect of the moon's action on the protuberant matter of the earth; and as we are ignorant of her quantity of matter, and conſequently of her influence in ſimilar circumſtances with the ſun, we ſhall ſuppoſe that the diſturbing force of the moon is to that of the ſun as m to 1. Then *(cæteris paribus)* the preceſſion will be to the ſolar preceſſion π in the ratio of the force and of the time of its action jointly. Let t and T therefore repreſent a periodical month and year, and the lunar proceſſion will be $= \frac{m\pi t}{T}$. This preceſſion muſt be reckoned on the plane of the lunar orbit, in the ſame manner as the ſolar preceſſion is reckoned on the ecliptic. We muſt alſo obſerve, that $\frac{m\pi t}{T}$ repreſents the lunar preceſſion only on the ſuppoſition that the earth's equator is inclined to the lunar orbit in an angle of 23½ degrees. This is indeed the mean inclination; but is ſometimes increaſed to above 28°, and ſometimes reduced to 18°. Now in the value of the ſolar preceſſion the coſine of the obliquity was employed. Therefore whatever is the angle E contained between the equator and the lunar orbit, the preceſſion will be $= \frac{m\pi t}{T} \cdot \frac{\text{Coſ. E}}{\text{Coſ. } 23\frac{1}{2}^\circ}$, and it muſt be reckoned on the lunar orbit.

47

Now let ♈B (fig. 8.) be the immoveable plane of the ecliptic, ♈ED♎F the equator in its firſt ſituation, before it has been deranged by the action of the moon, AGRDBH the equator in its new poſition, after the momentary action of the moon. Let EGNFH be the moon's orbit, of which N is the aſcending node, and the angle N=5° 8' 46''.

Let N♈ the long. of the node be -	z
Sine N♈ - - - -	x
Coſine N♈ - - - -	y
Sine ♈ =23½ - - -	a
Coſine ♈ - - - -	b
Sine N=5.8.46 - - -	c
Coſine N - - - -	d
Circumference to radius 1,=6,28 -	e

Force

Force of the moon - -	m
Solar preceſſion (ſuppoſed = $14\frac{1}{2}''$ by obſervation) - - -	π
Revolution of ☾ = $27^{d}\frac{1}{3}$ - -	t
Revolution of ☉ = $366\frac{1}{4}$ - -	T
Revolution of N = 18 years 7 months -	n

48 Lunar preceſſion in a month reduced to the ecliptic.

In order to reduce the lunar preceſſion to the ecliptic, we muſt recollect that the equator will have the ſame inclination at the end of every half revolution of the ſun or of the moon, that is, when they paſs through the equator, becauſe the ſum of all the momentary changes of its poſition begins again each revolution. Therefore if we neglect the motion of the node during one month, which is only $1\frac{1}{2}$ degrees, and can produce but an inſenſible change, it is plain that the moon produces, in one half revolution, that is, while ſhe moves from H to G, the greateſt difference that ſhe can in the poſition of the equator. The point D, therefore, half-way from G to H, is that in which the moveable equator cuts the primitive equator, and DE and DF are each 90°. But S being the ſolſtitial point, ♈S is alſo 90°. Therefore DS=♈E. Therefore, in the triangle DGE, we have ſin. ED : ſin. G=ſin. EG : ſin. D, =EG : D. Therefore D=EG× ſin. G, =EG× ſin. E nearly. Again, in the triangle ♈DA we have ſin. A : ſin. ♈D (or coſ. ♈E) = ſin. D : ſin. ♈A, = D : ♈A. Therefore

$$\Upsilon A = \frac{D\cdot\text{Coſ. }\Upsilon E}{\text{Sin. A}}, = \frac{EG\cdot\text{Sin. E}\cdot\text{Coſ. }\Upsilon E}{\text{Sin. }23\frac{1}{2}}, = \frac{m\pi t}{T}\;\frac{\text{Sin. E}\cdot\text{Coſ. E}\cdot\text{Coſ. }\Upsilon E}{\text{Sin. }\Upsilon\cdot\text{Coſ. }\Upsilon}.$$

49 This is the lunar preceſſion produced in the courſe of one month, eſtimated on the ecliptic, not conſtant like the ſolar preceſſion, but varying with the inclination or the angle E or F, which varies both by a change in the angle N, and alſo by a change in the poſition of N on the ecliptic.

50 Nutation in the ſame time,

We muſt find in like manner the nutation SR produced in the ſame time, reckoned on the colure of the ſolſtices RL. We have R : ſin. DS=D : RS, and RS=D · ſin. DS,=D · ſin. ahE. But D=EG · ſin. E. Therefore RS=EG · ſin. E · ſin. ♈E, $=\frac{m\pi t\ \text{Coſ. E}}{T\cdot\text{Coſ. }\Upsilon}$ × ſin. E × ſin. ♈E. In this expreſſion we muſt ſubſtitute the angle N, which may be conſidered as conſtant during the month, and the longitude ♈N, which is alſo nearly conſtant, by obſerving that ſin. E : ſin. ♈N=ſin. N : ſin. ♈E. Therefore $\text{RS}=\frac{m\pi t}{T}\times\frac{\text{Sin.N}\cdot\text{Sin.}\,\Upsilon\text{N}\cdot\text{Coſ.E.}}{\text{Coſ. }\Upsilon}$

But we muſt exterminate the angle E, becauſe it changes by the change of the poſition of N. Now, in the triangle EN♈ we have coſ. E=coſ. ♈N· ſin. N · ſin. ♈— coſ. N · coſ. ♈, $=yca-db$. And becauſe the angle E is neceſſarily obtuſe, the perpendicular will fall without the triangle, the coſine of E will be negative, and we ſhall have coſ. E$=bd-acy$. Therefore the nutation for one month will be $=\frac{m\pi t}{T}\times\frac{cx(bd-acy)}{b}$, the node being ſuppoſed all the while in N.

51 May be conſidered as momentary parts of the moon's action.

Theſe two expreſſions of the monthly preceſſion and nutation may be conſidered as momentary parts of the moon's action, correſponding to a certain poſition of the node and inclination of the equator, or as the fluxions of the whole variable preceſſion and nutation, while the node continually changes its place, and in the ſpace of 18 years makes a complete tour of the heavens.

52 Preceſſion and nutation compared.

We muſt, therefore, take the motion of the node as the fluent of compariſon, or we muſt compare the fluxions of the node's motion with the fluxions of the preceſſion and nutation; therefore, let the longitude of the node be z, and its monthly change$=\dot{z}$; we ſhall then have $t:n=\dot{z}:e$, and $t=\frac{n\dot{z}}{e}, =\frac{n\dot{x}}{e\sqrt{1-x^2}}$. Let T be = 1, in order that n may be 18,6, and ſubſtitute for t its value in the fluxion of the nutation, by putting $\sqrt{1-x^2}$ in place of y. By this ſubſtitution we obtain $m\pi n\frac{c}{eb}\left(\frac{dbx\dot{x}}{\sqrt{1-x^2}}-acx\dot{x}\right)$. The fluent of this is $m\pi n\frac{c}{eb}\left(-db\sqrt{1-x^2}-\frac{acx^2}{2}\right)$. (*Vide* Simpſon's Fluxions, § 77). But when x is $=o$, the nutation muſt be $=o$, becauſe it is from the poſition in the equinoctial points that all our deviations are reckoned, and it is from this point that the periods of the lunar action recommences. But if we make $x=o$ in this expreſſion, the term $-\frac{acx^2}{2}$ vaniſhes, and the term $-db\sqrt{1-x^2}$ becomes $=-db$; therefore our fluent has a conſtant part $+db$; and the complete fluent is $m\pi n\frac{c}{eb}\left(db-db\sqrt{1-x^2}-\frac{acx^2}{2}\right)$. Now this is equal to $m\pi n\frac{c}{eb}$(db× verſed ſine, $z-\frac{1}{4}ac$× verſed ſine $2z$): For the verſed ſine of z is equal to (1— coſ. z); and the ſquare of the ſine of an arch is $\frac{1}{2}$ the verſed ſine of twice that arch.

53 This, then, is the whole nutation while the moon's aſcending node moves from the vernal equinox to the longitude ♈N=z. It is the expreſſion of a certain number of ſeconds, becauſe π, one of its factors, is the ſolar preceſſion in ſeconds; and all the other factors are numbers, or fractions of the radius 1; even e is expreſſed in terms of the radius 1.

54 The fluxion of the preceſſion, or the monthly preceſſion, is to that of the nutation as the cotangent of ♈E is to the ſine of ♈. This alſo appears by conſidering figure 7. Pp meaſures the angle A, or change of poſition of the equator; but the preceſſion itſelf, reckoned on the ecliptic, is meaſured by Po, and the nutation by po; and the fluxion of the preceſſion is equal to the fluxion of nutation × $\frac{\text{cot. }\Upsilon E}{\text{ſine }\Upsilon}$, but cot. ♈E $=\frac{ad+bcy}{cx}$; therefore $\frac{\text{cot. }\Upsilon E}{\text{ſine }\Upsilon}=\frac{ad+bc\sqrt{1-x^2}}{cx}$: This, multiplied into the fluxion of the nutation, gives $\frac{m\pi n}{abe}\left(\frac{abd^2}{\sqrt{1-xx}}+(b^2-a^2)dc-abc^2.\sqrt{1-xx}\right)\dot{x}$ for the monthly preceſſion. The fluent of this $\frac{m\pi n}{abe}\left(ad^2bz+(b^2-a^2)dcx-\frac{1}{2}abc^2z-\frac{1}{2}abc^2x\sqrt{1-x^2}\right)$, or it is equal to $\frac{m\pi n}{abe}\left((d^2-\frac{1}{2}c^2)abz+(b^2-a^2)dcz-\frac{1}{4}abc^2\text{ ſine }2z\right)$.

55 Let us now expreſs this in numbers: When the node has made a half revolution, we have $z=180°$, whoſe verſed ſine is 2, and the verſed ſine of $2z$, or 360°, is $=0$; therefore, after half a revolution of the node, the nutation (n° 52.) becomes $\frac{m\pi n c}{eb} 2bd$. If, in this expreſſion, we ſuppoſe $m=2\frac{1}{2}$, and $\pi=14\frac{1}{2}''$, we ſhall find the nutation to be $19\frac{1}{5}''$.

56 Now the obſerved nutation is about 18″. This requires m to be $2\frac{1}{10}$, and $\pi=16\frac{1}{4}''$. But it is evident, that no aſtronomer can pretend to warrant the accuracy of his obſervations of the nutation within 1″.

To find the lunar preceſſion during half a revolution of the node, obſerve, that then z becomes $=\frac{e}{2}$, and the ſine of z and of $2z$ vaniſh, d^2 becomes $1-c^2$, and the preceſſion becomes $\frac{m\pi n}{2}(d^2-\frac{1}{2}c^2)$, $=\frac{m\pi n}{2}(1-\frac{3}{2}c^2)$, and the preceſſion in 18 years is $m\pi n\,\overline{1-\frac{3}{2}c^2}$.

57 We ſee, by comparing the nutation and preceſſion for nine years, that they are as $\frac{4cd}{e}$ to $1-\frac{3}{2}c^2$ nearly as 1 to $17\frac{1}{3}$. This gives 313″ of preceſſion, correſponding to 18″, the obſerved nutation, which is about 35″ of preceſſion annually produced by the moon.

58 Gives the diſturbing force and matter of the moon.

And thus we ſee, that the inequality produced by the moon in the preceſſion of the equinoxes, and, more particularly, the nutation occaſioned by the variable obliquity of her orbit, enables us to judge of her ſhare in the whole phenomenon; and therefore informs us of her diſturbing force, and therefore of her quantity of matter. This phenomenon, and thoſe of the tides, are the only facts which enable us to judge of this matter: and this is one of the circumſtances which has cauſed this problem to occupy ſo much attention. Dr Bradley, by a nice compariſon of his obſervations with the mathematical theory, as it is called, furniſhed him by Mr Machin, found that the equation of preceſſion computed by that theory was too great, and that the theory would agree better with the obſervations, if an ellipſe were ſubſtituted for Mr Machin's little circle. He thought that the ſhorter axis of this ellipſe, lying in the colure of the ſolſtices, ſhould not exceed 16″. Nothing can more clearly ſhow the aſtoniſhing accuracy of Bradley's obſervations than this remark: for it reſults from the theory, that the pole muſt really deſcribe an ellipſe, having its ſhorter axis in the ſolſtitial colure, and the ratio of the axes muſt be that of 18 to 16,8; for the mean preceſſion during a half revolution of the node is $\frac{m\pi n}{2}(d^2-\frac{c^2}{2})$; and therefore, for the longitude z, it will be $\frac{z m\pi n}{e}(d^2-\frac{c^2}{2})$; when this is taken from the true preceſſion for that longitude (n° 54.), it leaves the equation of preceſſion $\frac{m\pi n}{abe}\left((b^2-a^2)\,dc\cdot\text{ſine }z-\frac{1}{4}abc\text{ ſine }2z\right)$; therefore, when the node is in the ſolſtice, and the equation greateſt, we have it $=\frac{m\pi ncd}{abe}(b^2-a^2)$. We here neglect the ſecond term as inſignificant.

59 Greateſt equation of preceſſion.

This greateſt equation of preceſſion is to $\frac{2m\pi ncd}{6}$, the nutation of 18″, as b^2-a^2 to $2ab$; that is, as radius to the tangent of twice the obliquity of the ecliptic. This gives the greateſt equation of preceſſion 16″,8, not differing half a ſecond from Bradley's obſervations.

Thus have we attempted to give ſome account of this curious and important phenomenon. It is curious, becauſe it affects the whole celeſtial motions in a very intricate manner, and received no explanation from the more obvious application of mechanical principles, which ſo happily accounted for all the other appearances. It is one of the moſt illuſtrious proofs of Sir Iſaac Newton's ſagacity and penetration, which catched at a very remote analogy between this phenomenon and the libration of the moon's orbit. It is highly important to the progreſs of practical and uſeful aſtronomy, becauſe it has enabled us to compute tables of ſuch accuracy, that they can be uſed with confidence for determining the longitude of a ſhip at ſea. This alone fixes its importance: but it is ſtill more important to the philoſopher, affording the moſt inconteſtable proof of the univerſal and mutual gravitation of all matter to all matter. It left nothing in the ſolar ſyſtem unexplained from the theory of gravity but the acceleration of the moon's mean motion; and this has at laſt been added to the liſt of our acquiſitions by Mr de la Place.

> Quæ toties animos veterum torſere Sophorum,
> Quæque ſcholas fruſtra rauco certamine vexant,
> Obvia conſpicimus, nube pellente Matheſi,
> Jam dubios nulla caligine prægravat error
> Queis ſuperûm penetrare domos, atque ardua cœli
> Scandere ſublimis genii conceſſit acumen.
> Nec fas eſt propius mortali attingere divos.
>
> *Halley.*

PRECIÆ, (*precius*, "early,") the name of the 21ſt order in Linnæus's fragments of a natural method; conſiſting of primroſe, an early flowering plant, and a few genera which agree with it in habit and ſtructure, though not always in the character or circumſtance expreſſed in the title. See BOTANY, p. 461 col. 2.

PRECIPITANT, in chemiſtry, is applied to any liquor, which, when poured on a ſolution, ſeparates what is diſſolved, and makes it precipitate, or fall to the bottom of the veſſel.

PRECIPITATE, in chemiſtry, a ſubſtance which, having been diſſolved in a proper menſtruum, is again ſeparated from its ſolvent, and thrown down to the bottom of the veſſel, by pouring ſome other liquor upon it.

PRECIPITATION. See *CHEMISTRY-Index.*

PRECOGNITION, in Scots law. See LAW, Part III. n° CLXXXVI. 43.

PRECORDIA, in anatomy, a general name for the parts ſituated about the heart, in the forepart of the thorax: as the diaphragm, pericardium, and even the heart itſelf, with the ſpleen, lungs, &c.

PREDECESSOR, properly ſignifies a perſon who has preceded or gone before another in the ſame office or employment; in which ſenſe it is diſtinguiſhed from anceſtor.

1 The doctrine ſtated.

PREDESTINATION, the decree of God, whereby he hath from all eternity unchangeably appointed whatſoever comes to paſs; and hath more eſpecially fore-ordained certain individuals of the human race to everlaſting

PRECESSION of the EQUINOXES Plate CCCCXIV.

Fig. 1.

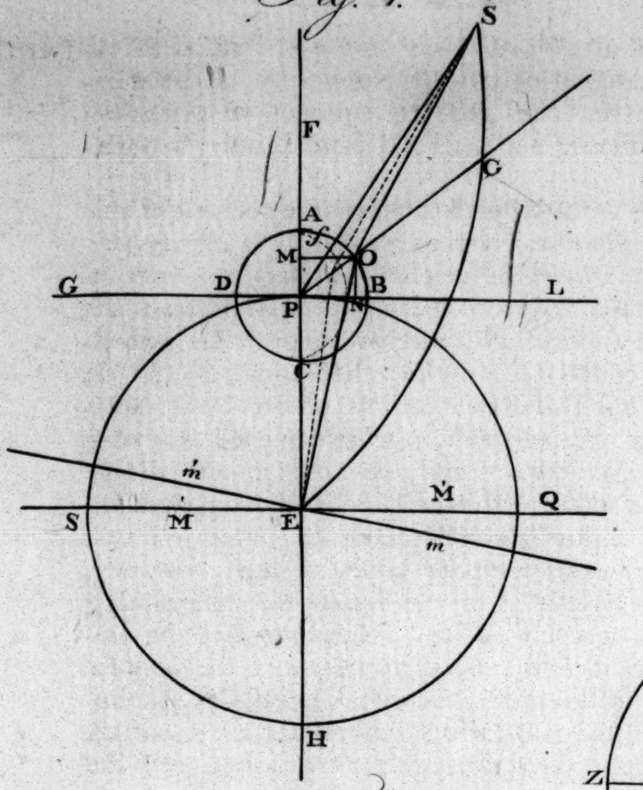
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Fig. 3.

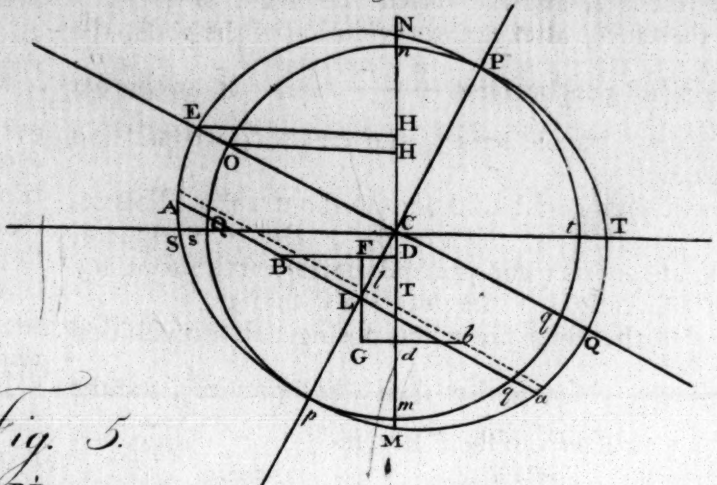
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Fig. 5.

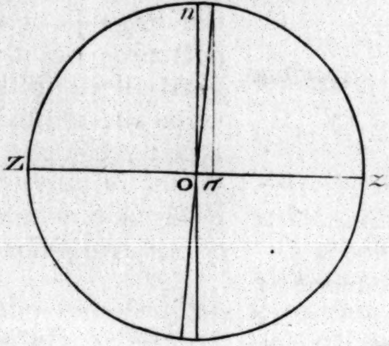

Fig. 4.

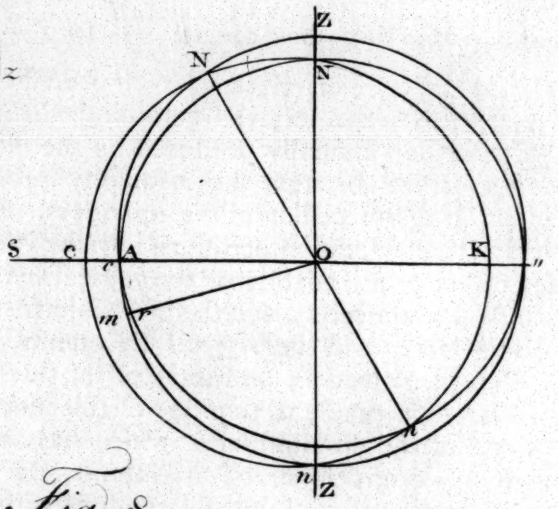
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Fig. 7.

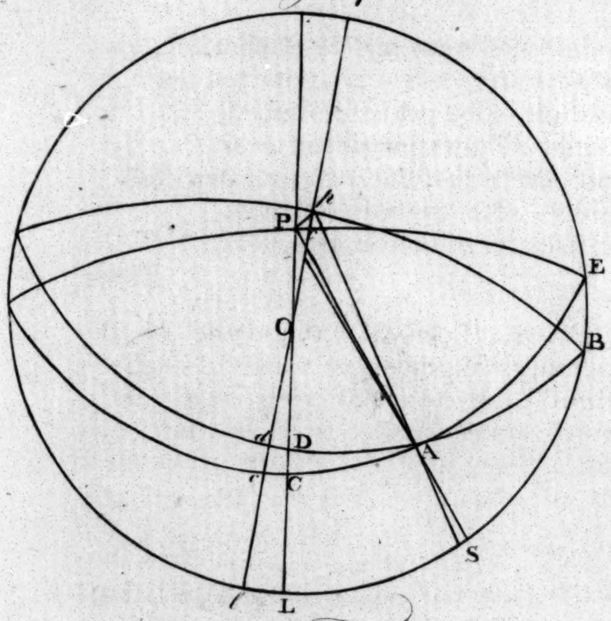
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Fig. 8.

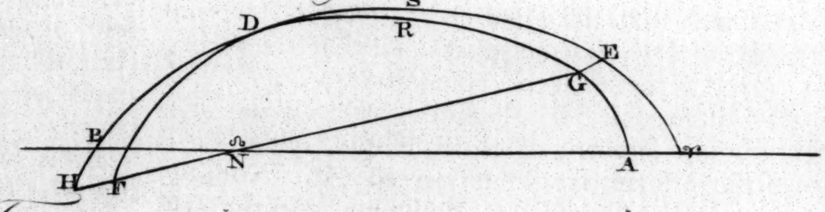
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Fig. 6.

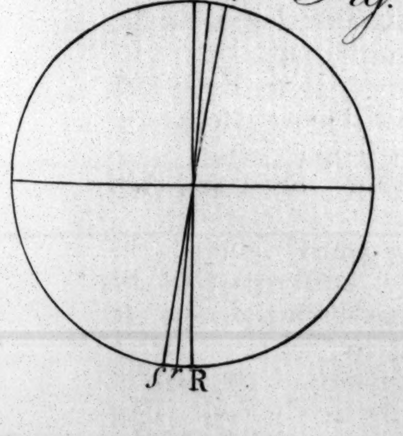
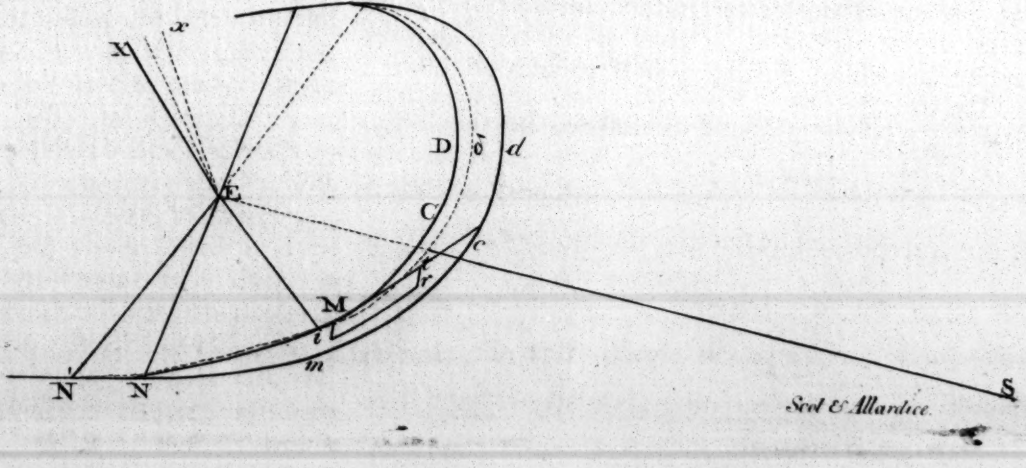


Fig. 2.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everlaſting happineſs, and hath paſſed by the reſt, and fore-ordained them to everlaſting miſery. The former of theſe are called the *elect*, and the latter are called the *reprobate*.

2 Not peculiar to Chriſtianity.

This doctrine is the ſubject of one of the moſt perplexing controverſies that has occurred among mankind. But it is not altogether peculiar to the Chriſtian faith. The opinion, that whatever occurs in the world at large, or in the lot of private individuals, is the reſult of a previous and unalterable arrangement by that Supreme Power which preſides over nature, has always been a favourite opinion among the vulgar, and has been believed by many ſpeculative men. Thus, in that beautiful ſcene in the ſixth book of the Iliad, Hector, taking leave of his wife and his child, ſpeaks thus:

> Andromache! my ſoul's far better part,
> Why with untimely ſorrows heaves thy heart?
> No hoſtile hand can antedate my doom,
> Till fate condemns me to the ſilent tomb.
> Fix'd is the term to all the race of earth,
> And ſuch the hard condition of our birth.
> No force can then reſiſt, no flight can ſave,
> All ſink alike, the fearful and the brave. l. 624.

The ancient Stoics, Zeno and Chryſippus, whom the Jewiſh Eſſenes ſeem to have followed, aſſerted the exiſtence of a Deity that, acting wiſely, but neceſſarily, contrived the general ſyſtem of the world; from which, by a ſeries of cauſes, whatever is now done in it unavoidably reſults. This ſeries, or concatenation of cauſes, they held to be neceſſary in every part; and that God himſelf is ſo much the ſervant of neceſſity, and of his own decrees, that he could not have made the ſmalleſt object in the world otherwiſe than it now is, much leſs is he able to alter any thing.

According to the words of Seneca, *Eadem neceſſitas et Deos alligat. Irrevocabilis divina pariter atque humana curſus vehit. Ille ipſe omnium conditor ac rector ſcripſit quidem fata ſed ſequitur. Semper paret, ſemel juſſit.* "The ſame chain of neceſſity conſtrains both gods and men. Its unalterable courſe regulates divine as well as human things. Even he who wrote the Fates, the Maker and Governor of all things, ſubmits to them. He did but once command, but he always obeys." The ſtoical fate differs, however, from the Chriſtian predeſtination in ſeveral points. They regarded the divine nature and will as a neceſſary part of a neceſſary chain of cauſes; whereas the Chriſtians conſider the deity as the Lord and Ruler of the Univerſe, omnipotent and free, appointing all things according to his pleaſure. Being doubtful of the immortality of the ſoul, the Stoics could have no idea of the doctrine of election and reprobation; nor did they ever doubt their own freedom or will, or power of doing good as well as evil, as we ſhall preſently ſee the Chriſtian predeſtinarians have done.

Mahomet introduced into his Koran the doctrine of an abſolute predeſtination of the courſe of human affairs. He repreſented life and death, proſperity and adverſity, and every event that befals a man in this world, as the reſult of a previous determination of the one God who rules over all; and he found this opinion the beſt engine for inſpiring his followers with that contempt of danger which, united to their zeal, has extended the empire of their faith over the faireſt portion of the habitable globe.

3 When firſt agitated in the church.

The controverſy concerning predeſtination firſt made its appearance in the Chriſtian church about the beginning of the fifth century †. Pelagius a Britiſh, and Cœleſtius an Iriſh, monk, both lived at Rome during that period, and poſſeſſed great celebrity on account of their piety and learning. They taught that the opinion is falſe, which aſſerts, that human nature is neceſſarily corrupted by a depravity derived from our firſt parents.—They contended, that men are born at preſent in a ſtate as pure as that in which Adam was originally created; and that they are not leſs qualified than he was for fulfilling all righteouſneſs, and for reaching the moſt ſublime eminence of piety and virtue: that the external grace of God, which is given unto all, and attends the preaching of the goſpel, is neceſſary to call forth the attention and exertions of men; but that we do not want the aſſiſtance of any internal grace to purify the heart, and to give it the firſt impulſe towards what is good. Having fled into Africa on account of the Goths, who at that time invaded Italy, A. D. 410, Cœleſtius remained at Carthage as a Preſbyter; but Pelagius went into the Eaſt, where he ſettled, and proſpered under the patronage of John biſhop of Jeruſalem, to whom his ſentiments were agreeable. On the contrary, the celebrated Auguſtine, biſhop of Hippo, ſtrenuouſly aſſerted the depravity of human nature ſince the fall of the firſt man, the neceſſity of a ſpecial interpoſition of divine grace to enable us to do any one good action; and conſequently, that none could obtain ſalvation excepting thoſe whom God has thought fit to elect, and upon whom he beſtows this grace. The diſpute was carried on with great zeal. Zozimus biſhop of Rome decided at firſt in favour of Pelagius and Cœleſtius, whoſe followers were called *Pelagians*; but he afterwards altered his opinion: and by the activity of Auguſtine, the council of Epheſus was called, at which the opinion of his antagoniſts was formally condemned.

4 Auguſtine a predeſtinarian.

In the courſe of the ſame century, theſe opinions aſſumed a variety of forms and modifications. One party, called *Predeſtinarians*, carried Auguſtine's doctrine fully farther than he himſelf had ventured to do in expreſs words; and aſſerted, that God had not only predeſtinated the wicked to *puniſhment*, but alſo that he had decreed that they ſhould commit thoſe very *ſins* on account of which they are hereafter to be puniſhed.—Another party moderated the doctrine of Pelagius, and were called *Semipelagians*. Their peculiar opinion is expreſſed in a different manner by different writers; but all the accounts ſufficiently agree. Thus, ſome repreſent them as maintaining that inward grace is not neceſſary to the firſt beginning of repentance, but only to our progreſs in virtue. Others ſay, that they acknowledged the power of grace, but ſaid that faith depends upon ourſelves, and good works upon God; and it is agreed upon all hands, that theſe Semipelagians held that predeſtination is made upon the foreſight of good works. The aſſiſtance of Auguſtine, though then far advanced in life, was called in to combat theſe tenets, and he wrote ſeveral treatiſes upon the ſubject. In all theſe he ſtrenuouſly maintained, that the predeſtination of the elect was independent of any foreſight

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† Moſheim. Inſtit. Hiſt. Eccl.

of their good works, but was according to the good pleaſure of God only; and that perſeverance comes from God, and not from man. Thereafter the doctrine of Auguſtine, or St Auſtin as he is often called, became general. He was the oracle of the ſchoolmen. They never ventured to differ from him in ſentiment; they only pretended to diſpute about the true ſenſe of his writings.

5 And all the earlieſt reformers, but more eſpecially Calvin.

The whole of the earlieſt reformers maintained theſe opinions of Auguſtine. They aſſumed under Luther a more regular and ſyſtematic form than they had ever formerly exhibited. But as the Lutherans afterwards abandoned them, they are now known by the name of *Calviniſtic Doctrines*, from John Calvin of Geneva. He aſſerted, that the everlaſting condition of mankind in a future world was determined from all eternity by the unchangeable decree of the Deity, ariſing from his ſole good pleaſure or free will. Being a man of great ability, induſtry, and eloquence, Geneva, where he taught, and which was a free ſtate, ſoon became the reſort of all the men of letters belonging to the reformed churches, and was a kind of ſeminary from which miſſionaries iſſued to propagate the Proteſtant doctrines through Europe. Their ſucceſs was ſuch, that, excepting a part of Germany, the principles of all the reformed churches are profeſſedly Calviniſtic or predeſtinarian.

6 Riſe of the Arminians

The opponents of the doctrine of predeſtination among the Proteſtants uſually receive the appellation of *Arminians* or *Remonſtrants*. They derive the firſt of theſe appellations from James Arminius, who was, A. D. 1602, appointed * profeſſor of theology at Leyden. He was violently oppoſed by Gomer his colleague, and died A. D. 1609. After his death, the controverſy was conducted with great eagerneſs on both ſides. The Calviniſts, however, gradually prevailed. A ſynod was called at Dort, A. D. 1618, to which the moſt celebrated divines of different countries were invited. There, in a great meaſure by the authority and influence of Maurice prince of Orange, the Arminians were condemned as heretics; for by this time ambitious and powerful men found themſelves politically intereſted in this religious conteſt. The Arminians preſented to this ſynod a remonſtrance, containing a ſtatement of their faith upon the ſubjects in diſpute; and from this they derived the appellation of *Remonſtrants*. This ſtatement contained the following five articles: 1. That God from all eternity predeſtinated thoſe to everlaſting ſalvation whom he foreſaw would believe in Chriſt unto the end of their lives; and predeſtinated obſtinate unbelievers to everlaſting puniſhment. 2. Jeſus Chriſt died for the whole human race, and for every individual of it, but believers alone reap the benefit of his death. 3. No man can produce faith in his mind by his own free will, but it is neceſſary that man, who is by nature wicked and unfit for acting or thinking aright, ſhould be regenerated by the grace of the Holy Spirit, imparted by God for Chriſt's ſake. 4. This divine grace conſtitutes the ſource, the progreſs, and the fulfilment, of all that is good in man; but it is not irreſiſtible in its operation. 5. Believers, by the aſſiſtance of the Holy Spirit, are abundantly fitted for every good work; but whether it is poſſible for thoſe who have once been truly ſuch to fall away, and to periſh finally, is not clear, and muſt be better inquired into by ſearching the ſacred ſcriptures.

7 Calviniſtic doctrine of predeſtination.

In oppoſition to theſe, a counter-remonſtrance was preſented, containing the opinions of the Calviniſts, which was approved of by the ſynod. The ſubſtance of it was afterwards adopted, and in nearly the ſame expreſſions, into the Confeſſion of Faith compiled by the aſſembly of divines which met at Weſtminſter, A. D. 1643, and which every clergyman and probationer for the miniſtry in Scotland is at preſent required to ſubſcribe previous to his admiſſion. To give as clear and as fair an idea as poſſible of the Calviniſtic doctrine upon this head, we tranſcribe the following paſſage from that Confeſſion: "God from all eternity did, by the moſt wiſe and holy counſel of his own will, freely and unchangeably ordain whatſoever comes to paſs; yet ſo, as thereby neither is God the author of ſin, nor is violence offered to the will of the creatures, nor is the liberty or contingency of ſecond cauſes taken away, but rather eſtabliſhed. Although God knows whatſoever may or can come to paſs upon all ſuppoſed conditions; yet hath he not decreed any thing becauſe he forſaw it as future, or that which would come to paſs upon ſuch conditions. By the decree of God, for the manifeſtation of his glory, ſome men and angels are predeſtinated unto everlaſting life, and others are fore-ordained to everlaſting death. Theſe angels and men, thus predeſtinated and fore-ordained, are particularly and unchangeably deſigned; and their number is ſo certain and definite, that it cannot be either increaſed or diminiſhed. Thoſe of mankind that are predeſtinated unto life, God, before the foundation of the world was laid, according to his eternal and immutable purpoſe, and the ſecret council and good pleaſure of his will, hath choſen, in Chriſt, unto everlaſting glory, out of his mere free grace and love, without any foreſight of faith, or good works, or perſeverance in either of them, or any other thing in the creature, as conditions or cauſes moving him thereunto; and all to the praiſe of his glorious grace. As God hath appointed the elect unto glory, ſo hath he, by the eternal and moſt free purpoſe of his will, fore-ordained all the means thereunto. Wherefore, they who are elected, being fallen in Adam, are redeemed by Chriſt, are effectually called unto faith in Chriſt, by his ſpirit working in due ſeaſon; are juſtified, adopted, ſanctified, and kept, by his power through faith unto ſalvation. Neither are any other redeemed by Chriſt, effectually called, juſtified, adopted, ſanctified, and ſaved, but the elect only. The reſt of mankind, God was pleaſed, according to the unſearchable council of his own will, whereby he extendeth or with-holdeth mercy as he pleaſeth, for the glory of his ſovereign power over his creatures, to paſs by, and to ordain them to diſhonour and wrath for their ſin, to the praiſe of his glorious juſtice."

8 Supralapſarians and Sublapſarians.

There are two kinds of Calviniſts or Predeſtinarians, viz. the *Supralapſarians*, who maintain that God did originally and expreſsly decree the fall of Adam, as a foundation for the diſplay of his juſtice and mercy; while thoſe who maintain that God only *permitted* the fall of Adam, are called *Sublapſarians*, their ſyſtem of decrees concerning election and reprobation being, as it were, ſubſequent to that event. But, as Dr Prieſtley juſtly remarks, if we admit the divine preſcience, there

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* Relatio Hiſtorica de Origine et Progreſſu Controverſiarum in Fœderato Belgio de Prædeſtinatione Philippi a Limborch.

is not, in fact, any difference between the two ſchemes; and accordingly that diſtinction is now ſeldom mentioned.

9 Diſputes in the church of Rome on the ſubject.

Nor is the church of Rome leſs agitated by the conteſt about predeſtination than the firſt Proteſtants were. The council of Trent was much perplexed how to ſettle the matter without giving offence to the Dominicans, who were much attached to the doctrine of Auguſtine, and poſſeſſed great influence in the council. After much diſpute, the great object came to be, how to contrive ſuch a decree as might give offence to nobody, although it ſhould decide nothing. Upon the whole, however, they ſeem to have favoured the Semipelagian ſcheme. Among other things, it was determined, that good works are of themſelves meritorious to eternal life; but it is added, by way of ſoftening, that it is through the goodneſs of God, that he makes his own gifts to be merits in us. Catarin revived at that council an opinion ot ſome of the ſchoolmen, that God choſe a ſmall number of perſons, ſuch as the bleſſed virgin, the apoſtles, &c. whom he was determined to ſave without any foreſight of their good works; and that he alſo wills that all the reſt ſhould be ſaved, providing for them all neceſſary means, but they are at liberty to uſe them or not. This is called the *Baxterian* ſcheme in England, from one of its promoters there. But at all events, the council of Trent ſeems to have been extremely anxious that any opinions entertained among them concerning predeſtination might have as little influence as poſſible upon practical morality. "Let no man (ſay they), while he remains in this mortal ſtate, preſume that he is among the number of the elect, and that therefore he cannot ſin, or ſin without repentance; for it cannot be known who are elected without a ſpecial revelation from God." Seſ. 6. c. 13.

The Jeſuits at firſt followed the opinion of Auguſtine; but they afterwards forſook it. *Molina*, one of their order, was the author of what is called the *middle ſcheme*, or the doctrine of *a grace ſufficient for all men*, but ſubject to the freedom of the human will. *Janſenius*, a doctor of Louvain, oppoſed the Jeſuits with great vigour, and ſupported the doctrine of Auguſtine. He wrote in a very artful manner. He declared, that he did not preſume to ſtate his own ſentiments upon the ſubject; he pretended only to explain and publiſh the ſentiments of that great father of the church St Auguſtine. But the Jeſuits, in conſequence of that inviolable ſubmiſſion to the authority of the pope which they always maintained, had ſufficient intereſt at Rome to procure the opinions of Janſenius to be condemned there; but with this addition ſubjoined, that nothing was thereby intended to be done in prejudice of the doctrine of St Auguſtine. This produced an abſurd diſpute about the pope's infallibility in matters of fact. The Janſeniſts affirmed, that the Pope had made a miſtake in condemning the opinions of Janſenius as different from thoſe of Auguſtine; whereas in truth they are the ſame, and the one cannot be condemned without the other. But the Jeſuits affirmed, that the pope is no leſs infallible in points of fact than he is in queſtions of faith; and he having decided, that the opinions of Janſenius are different from thoſe of St Auguſtine, every good Catholic is bound to believe accordingly that they are different. Theſe diſputes have never been fully ſettled, and ſtill divide the Roman Catholic churches. Some of the ableſt ſupporters of predeſtination have appeared among the Janſeniſts, and particularly among the gentlemen of Port Royal.

10 Engliſh and Scotch reformers predeſtinarians.

With regard to Great Britain, the earlieſt Engliſh reformers were in general Sublapſarians, although ſome of them were Supralapſarians. But the rigid Predeſtinarians have been gradually declining in number in that church, although they ſtill ſubſcribe the 39 articles of their faith, which are unqueſtionably Calviniſtic. The celebrated Scotch reformer John Knox having been educated at Geneva, eſtabliſhed in his country the doctrine of predeſtination in its ſtricteſt form: and it has probably been adhered to with more cloſeneſs in Scotland than in any country in Europe.

Of late years, however, the diſpute concerning predeſtination has aſſumed a form conſiderably different from that which it formerly poſſeſſed. Inſtead of being conſidered as a point to be determined almoſt entirely by the ſacred ſcriptures, in the hands of a number of able writers, it has in a great meaſure reſolved itſelf into a queſtion of natural religion, under the head of the philoſophical liberty or neceſſity of the will (A); or, whether all human actions are or are not neceſſarily determined

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(A) Dr Prieſtley, the moſt celebrated Neceſſarian of the age, has written a whole ſection of his *Illuſtrations*, with a view to ſhow, that between "the two ſchemes of Calviniſtic predeſtination and philoſophical neceſſity, there is no ſort of reſemblance, except that the future happineſs or miſery of all men is certainly foreknown and appointed by God. In all other reſpects (ſays he) they are moſt eſſentially different; and even where they agree in the *end*, the difference in the *manner* by which that end is accompliſhed is ſo very great, that the *influence* of the two ſyſtems on the minds of thoſe that adopt and act upon them is the reverſe of one another." The Calviniſtic doctrine of predeſtination, according to a very authentic ſtatement of that doctrine*, is, that "God, for his own glory, hath *fore-ordained whatſoever comes to paſs*." The ſcheme of philoſophical neceſſity, as ſtated by an intimate friend and warm admirer of Dr Prieſtley's, is, "That *every thing* is *predetermined* by the Divine Being; that whatever has been, muſt have been; and that whatever will be, muſt be; that *all events* are *pre-ordained* by infinite wiſdom and unlimited goodneſs; that the will, in all its determinations, is governed by the ſtate of mind; that this ſtate of mind is in every inſtance determined by the Deity; and that there is a continued chain of cauſes and effects, of motives and actions inſeparably connected, and originating from the condition in which we are brought into exiſtence by the Author of our being." The *author* or *compiler* of the ſame book affirms. "That all motion indeed originates in the Deity; that the Deity is ſelf-moved; that he poſſeſſes the ſingular attribute underived of moving himſelf." But it is added in the very ſame paragraph from which this laſt ſentence is quoted, that "the very argument we employ to prove one underived ſource of motion, and

* Shorter Catechiſm of the Aſſembly of Divines at Weſtminſter.

termined by motives ariſing from the character which God has impreſſed on our minds, and the train of circumſtances amidſt which his providence has placed us? We have already diſcuſſed this point (See METAPHYSICS) by giving a candid ſtatement of the arguments on both ſides of the queſtion. We ſhall treat the ſubject of predeſtination in the ſame manner, avoiding as far as poſſible any recapitulation of what has been advanced under the head of *NECESSITY and Liberty*.

11 Points at iſſue between the predeſtinarians and their opponents.

From what has been already ſaid, it will appear that the points chiefly at iſſue between the parties are the following: Firſt, With what views and purpoſes did God create the world and frame his decrees concerning mankind? Did he contrive a great unalterable ſcheme of creation and providence only for the ſake of manifeſting his own glory and perfections? Or did he firſt conſider the free motions of thoſe rational agents whom he intended to create, and frame his decrees upon the conſideration of what they might chooſe or do in all the various circumſtances in which he intended to place them?—The ſecond and following queſtions are branches of this leading one. Did Chriſt die for a particular portion of the human race, who ſhall therefore certainly be ſaved? or was his death intended as a benefit to all, from which none are excluded excepting thoſe who willingly reject it? Is the divine grace certainly and irreſiſtibly efficacious in all thoſe minds to which it is given? or does its effect depend upon the good uſe which men may or may not make of it? Can any good action be done without it? Do thoſe who have once received it certainly perſevere and obtain eternal ſalvation? or is it poſſible for any of them to fall away and periſh finally?

12 Arguments for the doctrine.

WE ſhall begin by ſtating the argument on the ſide of the predeſtinarians, and in the language which they commonly uſe. But it is neceſſary to make this previous remark, that the general * objections to their doctrine are, that it is hoſtile to all our ideas of the juſtice of God, repreſenting him as a partial being, rewarding without merit, and puniſhing without ſin; that it renders him the author of evil, deſtroys moral diſtinctions, makes uſeleſs every effort on our part, makes every prayer abſurd, and even the preaching of the goſpel vain; ſeeing that all things are immutably fixed, and none can believe or be ſaved excepting the elect, and they muſt certainly and at all events be ſafe. Againſt all this they reaſon thus.

The great and everlaſting Author of all things exiſted from eternity alone, independent and eſſentially perfect. As there was no other, he could only conſider himſelf and his own glory. He muſt therefore have deſigned all things in and for himſelf. To make him ſtay his determinations till he ſhould ſee what free creatures would do, is to make him decree with uncertainty, and dependently upon them, which falls ſhort of infinite perfection. He exiſted alone, and his councils could have no object excepting himſelf; he could only then conſider the diſplay of his own attributes and perfection. In doing this, as the end is more important than the means, Divine Wiſdom muſt begin its deſigns with that which is to come laſt in the execution of them; but the concluſion of all things at the laſt judgement will be the complete manifeſtation of the wiſdom, the goodneſs, and juſtice, of God: we muſt therefore ſuppoſe, that, in the order of things, he decreed that firſt, although with him, in the order of time, there is no firſt nor ſecond, but all is from eternity. When this great deſign was laid, the means were next deſigned. Creation, and its inhabitants of every order, form the means by which the author and diſpoſer of all things accompliſhes his will. But creatures in his ſight are nothing, and are figuratively ſaid to be leſs than nothing. We may entertain proud and elevated conceptions of our own dignity if we pleaſe; but if we in our deſigns regard not the duſt on which we tread, or the lives of ants and inſects, the omnipotent Lord of all, from whom we are more infinitely diſtant, muſt regard us as at leaſt equally inconſiderable, and only valuable as we ſerve the accompliſhment of his great and myſterious purpoſes, which cannot be us or our aggrandiſement, but himſelf and his own glory.

13 As neceſſary to explain the Divine attributes.

It is only by this view of the divine conduct that ſome of the attributes of God can be explained, or their exiſtence rendered poſſible. In the ſcriptures he claims the attribute of *preſcience* as his diſtinguiſhing prerogative: but there can be no preſcience of future contingencies; for it involves a contradiction to ſay, that things which are not certainly to be ſhould be certainly foreſeen. If they are certainly foreſeen, they *muſt* certainly be, and can therefore be no longer contingent. An uncertain foreſight is alſo an imperfect act, as it may be a miſtake, and is therefore inconſiſtent with divine perfection. On the other ſide the difficulty is eaſily explained. When God decrees that an event ſhall take place, its exiſtence becomes thenceforth certain, and as ſuch is certainly foreſeen. For it is an obvious abſurdity to ſay, that a thing happens freely, that is to ſay, that it may be or may not be, and yet that it is certainly foreſeen by God. He cannot foreſee things but as he decrees them, and conſequently gives them a future certainty of exiſtence; and therefore any preſcience antecedent to his decree muſt be rejected as impoſſible. Conditional decrees are farther abſurd, inaſmuch as they ſubject the purpoſes of God to the will and the actions of his creatures. Does he will, or wiſh that all mankind ſhould be ſaved, and ſhall they not all be ſaved? Infinite perfection can wiſh nothing but what it can execute; and if it is fit to wiſh, it is alſo fit to execute its wiſhes. We are indeed certainly informed by the ſcrip-

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and exiſtence, is a groſs ſolecism in logic; and that the aſcription of this power to the Divine Being is in fact nothing elſe than the leſs of two palpable *abſurdities* or rather *impoſſibilities*, if theſe could admit of degrees.†"

The piety of theſe aſſertions will be obvious, we are perſuaded, to every one of our readers; but to ſome it is poſſible that their conſiſtency may not be apparent. We would adviſe all ſuch "to peruſe once and again Dr Prieſtley's Illuſtrations," which, we have the beſt authority to ſay, will remove from their minds all Libertarian prejudices, convince them "that the hypotheſis of neceſſity is incontrovertibly true," and ſhow them that all the defenders of that hypotheſis are in perfect harmony with themſelves and with one another!

[*] Calvini Reſponſ. contra Pighalum, ad 2um lib.

[†] Eſſay on Philoſophical Neceſſity by Alexander Crombie, A. M.

ſcriptures, that all ſhall not be ſaved; and we therefore as certainly conclude, that God never intended that they ſhould be ſo; *for the counſel of the Lord ſtandeth faſt, and the thoughts of his heart, to all generations.*

14 Chriſt died only for the elect.

We conclude upon the ſame principles, that although the bleſſings reſulting from the death of Chriſt are offered to all, yet that intentionally and actually he only died for thoſe whom the Father had choſen and given to him to be ſaved by him. That Chriſt ſhould have *died in vain* is repreſented by the apoſtle Paul as a great abſurdity (Gal. ii. 21.): but if he died for all, he muſt have died in vain with regard to the greater part of mankind who are not to be ſaved by him. In ſo far as ſome inferior bleſſings are concerned, which through him are communicated, if not to all men, at leaſt to all Chriſtians, he may perhaps juſtly be ſaid to have died for all: but with regard to eternal ſalvation, his deſign, to avoid rendering it fruitleſs, could go no farther than the ſecret purpoſe and election of God. This is implied in theſe words, *all that are given me of my Father, thine they were, and thou gaveſt them me.* To theſe his interceſſion is limited; *I pray not for the world, but for thoſe that thou haſt given me; for they are thine, and all thine are mine, and mine are thine* (Jo. xvii. 9, 10.) Univerſal words are indeed uſed with regard to the death of Chriſt: but the reaſon is obvious, the Jewiſh religion was confined to the family and deſcendants of Abraham. In contradiction to this, the goſpel is ſaid to be preached to *every creature*, and *to all the world*; becauſe it is not limited to any one race or nation, and becauſe the apoſtles received a general commiſſion to teach it unto all who ſhould be willing to receive it. Theſe extenſive expreſſions can only be underſtood in this manner, becauſe in their ſtrict acceptation they have never been verified. Nor can their meaning be carried farther without an imputation upon the juſtice of God: for if he has received a ſufficient ſatisfaction for the ſins of the whole world, it is not juſt that all ſhould not be ſaved by it, or at leaſt have the offer of ſalvation made to them, that they may accept of it if they pleaſe.

But to return to the divine purpoſes and attributes in general: it is in vain to aſſert that God is partial and unjuſt while he prefers without merit, and predeſtinates to puniſhment thoſe who have not yet offended. The ſame error miſleads men here that has ſo often ſeduced them from the true path of ſcientific reſearch. Inſtead of ſubmitting to the patient and humble obſervation of nature, they boldly form ſome plauſible hypotheſis of their own, and vainly attempt to reconcile every appearance to their favourite ſyſtem. This mode of procedure never has proved, and never will prove, ſucceſsful in any branch of true philoſophy. We are not entitled to frame to ourſelves certain notions of the juſtice of God, and from theſe to decide that thus he muſt act and in no other manner. He takes no counſel from us concerning his conduct, and we have no right to rejudge his judgments. What he regards as juſt or unjuſt between himſelf and his creatures, is a queſtion of fact not to be known by ingenious conjectures, but by the cautious obſervations of the manner in which he acts in the courſe of his providence, and by attending to what he has declared concerning himſelf in the ſacred ſcriptures. If from theſe it ſhall appear that he does prefer where there is no merit, and reject where there is no crime; it will be in vain thereafter to aſſert that ſuch conduct is unjuſt: the fact will be on our ſide of the queſtion, and we ſhall leave thoſe to account for it who inſiſt that their limited reaſon is capable of comprehending all the myſterious ways of an Infinite Being.

15 Great inequalities in the ordinary courſe of providence.

In the courſe of providence, then, we ſee the greateſt inequalities take place, and ſuch as appear altogether contradictory to our ideas of juſtice. We ſee the ſins of the fathers puniſhed in the perſons of the children, who often derive debilitated bodies from the intemperance of their parents, and corrupted manners from the example of their vices. God frequently afflicts good men in this life for a great length of time, as in the caſe of Job, only for the manifeſtation of his own glory, that their faith and patience may be made manifeſt. Some ſins are puniſhed with other ſins, and often with a courſe of ſevere miſeries in the perſons of thoſe who never committed them. We may transfer this from time to eternity; for if God may do for a little time what is inconſiſtent with our notions, and with our rules of juſtice, he may do it for a longer duration: ſince it is as impoſſible that he can be unjuſt for a day as for all eternity: and the ſame inequality of management appears in the great as in the private affairs of this world. During many ages almoſt the whole human race were loſt in the darkneſs of idolatry: even ſince the Chriſtian religion came into the world, how few nations have received it; and of theſe few, the number is ſtill ſmaller of thoſe who have enjoyed it in tolerable purity. If we conſider how many great nations remain under the deluſion contrived by Mahomet; if we reflect upon the idolatry of the Indies and of China, and the ſuperſtition of the Greek church, and of the church of Rome—we ſhall find that very few nations have poſſeſſed the moſt ordinary means of grace. Even the bleſſings of civilization, of ſcience, and of liberty, are ſo rarely ſcattered over the face of the earth, that it is to be regarded as a melancholy truth, that with a very few favoured exceptions the whole human race have hitherto been ſunk in the depth of barbariſm, ignorance, ſlavery, and idolatry. When the Arminians think fit to aſſert, then, that the doctrine of abſolute decrees is contrary to their ideas of the impartiality and juſtice of God, we can only anſwer that we are ſorry for them if they have formed ideas of the character of God which are contrary to the truth. We preſume not * like them to call his attributes before the tribunal of our underſtandings; we only obſerve the ways of his providence, and declare that thus ſtands the fact. If he leaves whole nations in darkneſs and corruption, and freely chooſes others to communicate the knowledge of himſelf to them, we need not be ſurpriſed if he act in the ſame manner with individuals. For ſurely the rejecting immenſe empires for ſo many ages is much more unaccountable than the ſelection of a few individuals, and the leaving others in ignorance and depravity. It is in vain to allege that he extends his mercy to thoſe who make the beſt uſe of the dim light which they have. This does not remove the difficulty of a choice and a preference; as it cannot be denied that their condition is very deplorable, and that the condition of others is much more hopeful: ſo that the myſterious doctrine of election and reprobation is an unqueſtionable truth under the government of God, ſeeing that great numbers of men are born in ſuch circumſtances that it is morally impoſſible they ſhould not periſh in them; whereas others are more happily ſituated and enlightened.

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* Calvini Tract. de Eterna Dei Prædeſt.

16 The language of Scripture predeſtination. Nor are we left to common obſervation upon this point. The language of the ſacred ſcriptures is poſitive and clear. The whole reaſoning in the ninth chapter to the Romans reſolves all the acts of God's juſtice and mercy, his *hardening* as well as his *pardoning*, into an abſolute freedom and an unſearchable depth. More pointed expreſſions for this purpoſe can ſcarcely be conceived than thoſe actually made uſe of. *For the children being not yet born, neither having done any good or evil, that the purpoſe of God according to election might ſtand, not of works, but of him that calleth, it was ſaid, The elder ſhall ſerve the younger. As it is written, Jacob have I loved, but Eſau have I hated. What ſhall we ſay then? Is there unrighteouſneſs with God? God forbid. For he ſaith to Moſes, I will have mercy on whom I will have mercy, and I will have compaſſion on whom I will have compaſſion, So then it is not of him that willeth, nor of him that runneth, but of God that ſheweth mercy; for the ſcripture ſaith unto Pharaoh, Even for this ſame purpoſe have I raiſed thee up, that I might ſhow my power in thee, and that my name might be declared throughout all the earth. Therefore hath he mercy on whom he will have mercy, and whom he will he hardeneth.* 17 An objection anſwered. If any man ſhall ſtill be ſufficiently bold to declare that all this is contrary to what he is pleaſed to conſider as juſt and impartial, we can only reply to him in the words of the celebrated John Calvin of Geneva †. *Tibi moleſtum eſt ac odioſum, Deum plus poſſe et facere, quam mens tua capiat; æquali autem tuo interdum concedes, ut ſuo judicio fruatur. Et tu in tanto furore, Dei mentionem ullam facere audes?* "Is it painful to thee that the power and the works of God exceed thy limited capacity? Thou ſometimes ſuffereſt thine equal to judge of his own conduct for himſelf, and dareſt thou in thy folly to cenſure the ways of God?" Or rather we may reply in thoſe words of the apoſtle Paul which immediately follow the paſſage already quoted. *Thou wilt ſay then to me, Why doth he yet find fault? for who hath reſiſted his will? Nay but, O man, who art thou that repliеſt againſt God? Shall the thing formed ſay to him that formed it, Why haſt thou made me thus? Hath not the potter power over the clay; of the ſame lump to make one veſſel unto honour, and another unto diſhonour?* Let theſe paſſages, and even the whole of the chapter now alluded to, be explained in any manner that is judged proper, ſtill their import with regard to the preſent argument will remain the ſame. If God loved Jacob ſo as to chuſe his poſterity to be his people, and rejected or hated Eſau and his poſterity, and this without regard to them or their future conduct, but merely in conſequence of the purpoſe and deſign of his election; if by the ſame purpoſe the Gentiles were to be grafted upon that ſtock from which the once favoured Jews were cut off; it will follow, not only that the great and myſterious decree of final election is unſearchably free and abſolute, but alſo that all the means of grace are granted or withheld in the ſame unlimited and free manner according to the ſovereign will and good pleaſure of God, independent of any foreſight of merit on our part. The words of our Saviour expreſs this: *I thank thee O Father, Lord of heaven and earth, becauſe thou haſt hid theſe things from the wiſe and prudent, and haſt revealed them unto babes:* The reaſon of which is given in the following words, *Even ſo, Father, for ſo it ſeemed good in thy ſight*, (Mat. xi. 26). The paſſage immediately preceding this, ſhows clearly that the means of grace are not beſtowed upon thoſe who, it is foreſeen, will make a good uſe of them; nor denied to thoſe who will make a bad uſe of them. *Wo unto thee Chorazin, wo unto thee Bethſaida: for if the mighty works which were done in you had been done in Tyre and Sidon, they would have repented long ago in ſackcloth and aſhes.* But the paſſages in ſcripture are innumerable, which declare that the whole character and deſtiny of every man is the reſult of the counſel and uncontrouled determination of God. The expreſſion is often repeated in the book of Exodus; God *hardened the heart of Pharaoh, ſo that he would not let his people go*, (Exod. iv. 21), &c. It is ſaid, that *God has made the wicked man for the day of evil* (Prov. xvi. 4). On the other hand, it is ſaid, *as many believed the goſpel as were appointed to eternal life*, (Acts i. 48). Some are ſaid to be *written in the book of life, of the Lamb ſlain from the foundation of the world* (Rev. xiii. 8). Every prayer that is uſed, or directed to be uſed, in ſcripture, is for a grace that opens our eyes, that turns the heart, that makes us to go, that leads us not into temptation, but delivers us from evil. All theſe expreſſions denote that we deſire more than a power or capacity to act, ſuch as is given to all men. Indeed we do not, and we cannot, pray earneſtly for that which we know all men as well as ourſelves poſſeſs at all times.

18 Sure efficacy of grace. The *grace of God* is the medium by which his ſovereign will and abſolute decrees are accompliſhed. Accordingly, it is ſet forth in ſcripture by ſuch expreſſions as clearly denote its ſure efficacy; and that it does not depend upon us to uſe it or not at our pleaſure. It is ſaid to be a creation; *we are created unto good works, and we become new creatures:* It is called a regeneration, or a *new birth;* it is called a quickening and a reſurrection, as our former ſtate is compared to a feebleneſs, a blindneſs, and a death. God is ſaid *to work in us both to will and to do: His people ſhall be willing in the day of his power: He will write his laws in their hearts, and make them to walk in them.* In a paſſage already quoted, the human race are compared to a maſs of *clay* in the hands of the *potter*, who of the ſame lump makes at his pleaſure *veſſels of honour and diſhonour.* Theſe paſſages, and this laſt more particularly, prove that there is an abſolute and a conquering power in divine grace; and that the love of God conſtrains us, as St Paul expreſſes himſelf. Our Saviour compares the union and influence that he communicates to believers to the union of an head with the members, and of a root with the branches, which imparts an internal, a vital, and an efficacious influence. The outward means may indeed be rejected, but this overcoming grace never returns empty: theſe outward means coming from God, the reſiſting of them is ſaid to be the *reſiſting* of God, the *grieving* or *quenching of his ſpirit;* and in that ſenſe we may reſiſt the grace or favour of God; but we can never withſtand him when he intends to overcome us; *For the foundation of God ſtandeth ſure, having this ſeal, The Lord knoweth them that are his*, (2 Tim. ii. 19). *Having prediſtinated us unto the adoption of children by Jeſus Chriſt himſelf, according to the good pleaſure of his will*, (Eph. i. 5).

19 Perſeverance of the ſaints. That the ſaints ſhall certainly perſevere unto the end is a neceſſary conſequence of abſolute decrees and of efficacious grace: all depends on God. He *of his own will begat us;* and with him *there is no variableneſs nor ſhadow of turning: whom he loves, he loves to the end:* and he has promiſed that he will never leave nor forſake thoſe to whom he becomes a God. Our Lord hath

† Ubi ſupra.

hath ſaid, *I give unto them eternal life, and they ſhall never periſh; neither ſhall any pluck them out of my hand*, (Jo. x. 28.) Hence we muſt conclude, that *the purpoſe and calling of God is without repentance*, (Heb. xiii. 5.) And therefore, although good men may fall into great ſins, yet of all thoſe who are given by the father to the Son to be ſaved by him, none are loſt: The concluſion from the whole is, that God did in himſelf, and for his own glory, *foreknow* a determinate number in whom he would be both ſanctified and glorified. Theſe he *predeſtinated* to be holy, conformable to the image of his ſon: they are to be *called*, not by a general calling in the ſenſe of theſe words, *many are called, but few are choſen*; but to be *called according to his purpoſe*. He *juſtified* them upon their obeying that calling, and in the concluſion he will *glorify* them; for nothing can ſeparate us from the love of God in Chriſt, (Rom. ix. 19.) And he is not leſs abſolute in his decree of reprobation than he is in his election: for *ungodly men* are ſaid to be *of old ordained to condemnation, and to be given up by God unto vile affections, and to be given over by him to a reprobate mind*.

20
Arguments againſt the doctrine from the attributes of God.

THUS far we have defended the doctrine of predeſtination: we proceed next to ſtate the arguments uſually adduced in favour of the Arminian ſyſtem.

God is juſt, holy and merciful. In ſpeaking of himſelf in ſcripture, he is pleaſed to make appeals to the human underſtanding, and to call upon men to reaſon with him concerning his ways. The meaning of this is, that men may examine his actions and his attributes with that meaſure of intelligence which they poſſeſs, and they will be forced to approve of them; nay, he propoſes himſelf to us as a pattern for our imitation. We are required to be holy as he is holy, and merciful as he is merciful: which is a proof that he accounts us not incapable of forming juſt notions at leaſt of theſe attributes. What then can we think of a juſtice that ſhall condemn us for a fact that we never committed? that deſigns firſt of all to be glorified by our being eternally miſerable, and which afterwards decrees that we ſhall commit ſins to juſtify this previous decree of our reprobation? For if God originally deſigns and determines all things, and if all his decrees are certainly effected, it is inconceivable how there ſhould be a juſtice in puniſhing that which he himſelf, by an antecedent and irreverſible decree, appointed to be done. Or, ſetting juſtice aſide, is it poſſible that a being of infinite holineſs, and who is *of purer eyes than to behold iniquity*, would by an antecedent decree fix our committing ſo many ſins, in ſuch a manner that it is not poſſible to avoid them? He repreſents himſelf in the ſcriptures as *gracious, merciful, ſlow to anger, and abundant in goodneſs and truth*. It is often ſaid, that *he deſires that no man ſhould periſh, but that all ſhould come to the knowledge of the truth*: this is even ſaid with the ſolemnity of an oath, *As I live, ſaith the Lord, I take no pleaſure in the death of ſinners*. What ſenſe can theſe words bear if we believe that God did by an abſolute decree doom ſo many of them to everlaſting miſery? If all things that happen ariſe out of the abſolute decree of God as their firſt cauſe, then we muſt believe that God takes pleaſure both in his own decrees and in the execution of them, conſequently that *he doth take pleaſure in the death of ſinners*; and this in expreſs contradiction to the moſt poſitive language of ſcripture. Beſides all this what are we to think of the truth of God, and of the ſincerity of thoſe offers of grace and mercy, with the exhortations and expoſtulations upon them that occur ſo frequently in ſcripture, if we can imagine that by antecedent acts he determined that all theſe ſhould be ineffectual? In one word, are we to regard our exiſtence as a bleſſing, and to look up with gratitude to that paternal goodneſs which has placed us in a *land* of hope, which formed our nature, weak indeed and expoſed to many imperfections, but capable of riſing by virtuous efforts and by a patient continuance in well-doing to excellence and to high and immortal felicity? or, are we to curſe the hour in which we were born under the dominion of a maſter, who is not only ſevere, but abſurd, and even adds inſult to cruelty; who, after placing us in a goodly habitation, binds us hand and foot, locks the door, blocks up the windows, ſets fire to the fabric, and then very mercifully calls upon us to come forth leſt we periſh?

It is not true that rational beings are nothing in the ſight of their maker. Compared to his Almighty ſtrength and uncreated exiſtence, our powers do indeed diminiſh into weakneſs, and our years into a moment: yet although our intereſts may be unimportant in themſelves, the attributes of God with which they are connected are far from being ſo. There was no neceſſity for his calling us into exiſtence; but the inſtant he beſtowed upon us that gift, and conferred upon us faculties capable of riſing to happineſs by the contemplation of himſelf and of his works, he became our parent, and granted to us a right to look up to him for protection and mercy, and to hope that our exiſtence and our faculties were not beſtowed in vain. Nor will he trample upon the juſt and reaſonable hopes of the meaneſt of his creatures. He is watchful over our intereſts; he hath ſent his Son to die for us; his providence has been exerted for no other purpoſe but to promote our welfare; and there is joy in heaven even over one ſinner that repenteth. Let it be allowed, that the univerſe was formed for no other purpoſe but to promote the glory of God; that glory can ſurely be little promoted by the exertion of undiſtinguiſhing and blind acts of power, in the arbitrary appointment to eternal reprobation of millions of unreſiſting and undeſerving wretches*. It is not more honourable to the Deity to conceive of him as the parent, guide, governor, and judge of free beings, formed after the likeneſs of himſelf, with powers of reaſon and ſelf-determination, than to conceive of him, as the former and conductor of a ſyſtem of conſcious machinery, or the mover and controuler of an univerſe of puppets, many of whom he is pleaſed to make completely miſerable? The moſt important and fundamental point of religion, conſidered as a ſpeculative ſcience, conſiſts in our forming high and juſt ideas of God and of his attributes, that from them we may underſtand the maxims of true and perfect morality. But were we to attempt to form our own natures upon the idea of the divine character that is given us by the doctrine of abſolute decrees, we would certainly become imperious, partial, and cruel; at leaſt we ſhould not readily learn the virtues of kindneſs, mercy, and compaſſion.

21
The difficulty of preſcience ſolved.

It is true that, ſetting aſide predeſtination, it is not eaſy to ſhow how future contingencies ſhould be certainly foreſeen; but it is obvious that ſuch foreſight involves no contradiction, (ſee METAPHYSICS, n° 308); and if the actions of men be free, we know from the train of prophecies, which in the ſacred ſcriptures appear to have been made in one age and fulfilled in another, that contingencies are foreſeen by that infinite Being who inhabiteth eternity, and to whom a thouſand years are but as one day. The prophecies concerning the death and ſufferings of Chriſt were fulfilled by the free acts of the Jewiſh prieſts and people: Theſe men ſinned in accompliſhing that event, which proves that they acted with their natural liberty. From theſe and all the other prophecies both in the old and new Teſtament, it muſt be confeſſed that future contingencies were certainly foreknown, but where to found that certainty cannot be eaſily reſolved. We doubt not, however, that we may ſafely refer it to the infinite perfection of the Divine mind. And it ought to be obſerved that this difficulty is of a very different nature from that to which our antagoniſts are reduced on their ſide of the argument. They are compelled to confeſs that they cannot reconcile their doctrine with the juſtice of God, an attribute the nature of which we clearly underſtand, and which is held forth to our imitation; whereas we are only at a loſs how to explain the mode in which the divine preſcience is exerted; an attribute which God claims as peculiarly his own, and which it is not to be expected that we ſhould be able in the ſmalleſt degree to comprehend. We can go farther than this. Heaven hath given to man two revelations of itſelf. The one conſiſts in the knowledge which we procure by the right uſe of our rational faculties; and the other is beſtowed by means of the ſacred ſcriptures. Without intending to derogate from the authority of inſpiration, it is fair to aſſert, that we are *more certain* that God is the author and beſtower of our reaſon, than that he is the author of the ſcriptures; at leaſt it is certain that the laſt cannot contradict the firſt, becauſe God cannot contradict himſelf. By the primary revelation from heaven then, that is, by our reaſon, we are informed that God is true, and juſt, and good. If an angel from heaven ſhould preach a doctrine contrary to this, we are entitled to ſay with the apoſtle, *let him be accurſed.* If our antagoniſts then ſhould ſucceed in proving that the doctrine of abſolute decrees, which repreſents the Deity as cruel and unjuſt, is contained in ſcripture, the conſequence would be, not that we would believe it, for that is impoſſible, but that we ſhould be reduced to the neceſſity of rejecting the authority of the ſcriptures, becauſe they contradict the previous ſure revelation of God, our reaſon. We believe that the doctrines contained in the ſcriptures are certainly true, becauſe they were taught by thoſe who wrought miracles and foretold future events in proof of their being inſpired by the God of truth. But miracles and prophecy are *direct* evidences of nothing but the *power* and *wiſdom* of their Author; and unleſs we know by other evidence, that this powerful and wiſe Being is likewiſe the father of truth and juſtice, we cannot be ſure that the ſcriptures, notwithſtanding their ſource, are any thing better than a tiſſue of falſehoods. The very arguments therefore by which predeſtination is ſupported, tend to ſap the foundation of that revelation from which its advocates pretend to draw them. The caſe is very different when no doctrine is aſſerted that is not contradictory to our reaſon, but only above it. For example, when we are told that God can create rational beings, that he attends without diſtraction to the minuteſt affairs that paſs in a thouſand worlds, that he knows all things, the paſt, the preſent, and the future, we do not preſume that we comprehend how he can do all this: but there is nothing in it that contradicts our reaſon; we ourſelves poſſeſs a certain degree of power, can attend at once to a certain number of objects, can in ſome caſes form very ſure conjectures about futurity, and we reſolve all the reſt into the infinite nature and perfections of God.

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* Correſpondence between Price and Prieſtely

22
Scripture cannot contradict the clear dictates of reaſon.

It is farther to be obſerved, that preſcience does not make effects certain becauſe they are foreſeen; but they are foreſeen becauſe they are to be: ſo that the certainty of the preſcience is not the cauſe, but the conſequence of the certainty of the event. The Roman republic has fallen; but our knowledge or ignorance of that event does not render it more or leſs true and certain. That it was to fall, was as ſurely true before it happened as it is now; and had we known it beforehand, as many men of ſenſe probably did, it would neither have fallen ſooner nor later on that account. This ſhows that the knowledge which an intelligent being has of a paſt or future event need not have any influence upon the circumſtances that produce that event.

23
Conditional preſcience.

On ſome occaſions the ſcripture takes notice of a conditional preſcience *. God anſwered David, that Saul would come to Keilah, and that the men of Keilah would deliver him up: yet both the one and the other reſted upon the condition of his ſtaying there; and he going from thence, neither of them ever happened. Such alſo was the † prophecy of Jonah, at the failure of which he was ſo abſurdly offended: and ſuch was Chriſt's ſaying, That thoſe of Tyre and Sidon, Sodom and Gomorrah would have turned to him, if they had ſeen the miracles that he wrought in the towns of Galilee. Since, then, this preſcience may be ſo certain that it can never err nor miſlead the exertions of providence, and ſince by this, both the attributes of God are vindicated, and the due freedom of man is aſſerted, all difficulties ſeem to be thus eaſily removed.

24
Chriſt died for the whole world.

With regard to the purpoſe of Chriſt's death, he is ſaid to be the *propitiation for the ſins of the whole world;* and the wicked are ſaid *to deny the Lord that bought them.* His death, as to its extent, is ſet in oppoſition to the ſins of *Adam;* ſo that as by the offence of one judgment came upon all men to condemnation, ſo by the righteouſneſs of one the free gift came upon all men to juſtification of life, (Rom. v. 18.) The *all* on the one ſide muſt be as extenſive as the *all* on the other: ſo, ſince *all* are concerned in Adam's ſin, *all* muſt likewiſe be concerned in the death of Chriſt. To this we may add, that *all* men are commanded and required to believe that Chriſt died for their ſins; but no man can be obliged to believe what is not true: he muſt therefore have died for *all.* The following paſſages expreſs clearly the univerſality of the object of Chriſt's death. *If any man ſin, we have an advocate with the Father, Jeſus Chriſt the righteous: and he is the propitiation for our ſins: and not for ours only, but alſo for the ſins of the whole world,* (1 Jo. ii. 1, 2.) *The love of Chriſt conſtraineth us; becauſe we thus judge, that if one died for all, then were all dead: and that he died for all, that they which live*

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* 1 Sam. xxiii. 11, 12.

† Chap. iii.

ſhould not henceforth live unto themſelves, (2 Cor. v. 14.) *God ſo loved the world that he gave his only begotten Son that whoſoever believeth in him might not periſh, but might have everlaſting life.* (Jo. iii. 16.)

25 Freedom eſſential to moral agents.

But a proper attention to the nature of man will ſet the juſtice of our argument in a ſtill ſtronger point of view. It is obvious, that ſuch an inward freedom as renders a man the maſter of his own conduct, and able to do or not do what he pleaſes, is ſo neceſſary to the morality of our actions, that without it they are neither good nor evil, neither capable of rewards nor puniſhments. Madmen, or men aſleep, are not to be charged with the good or evil of what they do; therefore at leaſt ſome ſmall degree of liberty muſt be left us, otherwiſe why are we praiſed or blamed for our conduct? All virtue and religion, all diſcipline and induſtry, ariſe out of this as their firſt principle, that there is a power in us to govern our own thoughts and actions, and to raiſe and improve our faculties. If this is denied, all efforts, all education, all attention beſtowed upon ourſelves or others, become fruitleſs and vain. If a man accounts himſelf under an inevitable decree, as he will have little remorſe for the evil he does while he imputes it to that inevitable force that conſtrains him, ſo he will naturally conclude that it is to no purpoſe for him to ſtruggle with impoſſibilities. Men are ſufficiently inclined to throw all cenſure off from themſelves, and to indulge in indolence; and upon the doctrine of abſolute predeſtination who can blame them, ſeeing that their efforts can be of no value?

26 Liberty or neceſſity a queſtion of fact.

Matter is inactive of itſelf, and only moves in conſequence of its being acted upon by ſome other being. Man is poſſeſſed of a power to begin motion, and to determine it in any direction that he may judge proper. This power and this intelligence conſtitute his liberty, and form that image of God that is ſtamped upon his nature. Whether man poſſeſſes this power of acting originally and of himſelf, or whether he is incapable of forming any reſolution, or making any effort, without being acted upon by a foreign cauſe, is not a point to be reaſoned on or diſputed about: it is a queſtion of fact, which, as far as it can poſſibly be known, every man has it in his power to determine by the evidence of his own conſciouſneſs. We do aver, then, that every man is conſcious that he is a free agent, and that it is not poſſible for the moſt ſtaunch predeſtinarian that has ever yet appeared ſeriouſly and practically to convince himſelf of the contrary. It is not poſſible for a man in his ſenſes to believe, that in all thoſe crimes which men charge *themſelves* with, and reproach *themſelves* for, God is the agent; and that, properly ſpeaking, they are no more agents than a ſword is when employed to commit murder. We do indeed, on ſome occaſions, feel ourſelves hurried on ſo impetuouſly by violent paſſions, that we ſeem for an inſtant to have loſt our freedom; but on cool reflection we find, that we both might and ought to have reſtrained that heat in its firſt commencement. We feel that we can divert our thoughts, and overcome ourſelves in moſt inſtances, if we ſet ſeriouſly about it. We feel that knowledge, reflection, and proper ſociety, improve the temper and diſpoſition; and that ignorance, negligence, and the ſociety of the worthleſs and abandoned, corrupt and degrade the mind. From all this we conclude, that man is free, and not under inevitable fate, or irreſiſtible motions to good or evil. This concluſion is confirmed by the whole ſtyle of ſcripture, which upon any other ſuppoſition becomes a ſolemn and unworthy mockery. It is full of perſuaſions, exhortations, reproofs, expoſtulations, encouragements, and terrors. But to what purpoſe is it to ſpeak to dead men, to perſuade the blind to ſee, or the lame to run? If we are under impotence till the irreſiſtible grace comes, and if, when it comes, nothing can withſtand it, what occaſion is there for theſe ſolemn diſcourſes which can have no effect? They cannot render us inexcuſable, unleſs it were in our power to be improved by them; and to imagine that God gives light and bleſſings, which can do no good, to thoſe whom he before intended to damn, only to make them more inexcuſable, and for the purpoſe of aggravating their condemnation, gives ſo ſtrange an idea of his character as it is not fit to expreſs in the language that naturally ariſes out of it.

27 Some of the acts of God depend on the conduct of his creatures.

Our antagoniſts ſeem to have formed ideas of the divine perfection and ſovereignty that are altogether falſe. There is no imperfection implied in the ſuppoſition that ſome of the acts of God may depend upon the conduct of his creatures. Perfection conſiſts in forming the wiſeſt deſigns, and in executing them by the moſt ſuitable means. The author of nature conducts the planets in their orbits with immutable preciſion according to fixed rules: but it would be abſurd to pretend to manage free agents, or their affairs, in the ſame manner by mathematical or mechanical principles. The providence that is exerted over material objects is fixed and ſteady in its operations, becauſe it is fit that material objects which cannot move of themſelves ſhould be moved in a regular manner: but free and intelligent beings enjoy a wider range, and ought not to be confined to a preſcribed train of exertions; it may therefore be neceſſary that the providence which ſuperintends them ſhould accommodate itſelf to circumſtances. This, however, is not injurious to the divine ſovereignty; for God himſelf is the author of that freedom of agency which he is pleaſed to watch over. He is not leſs the Lord of the univerſe; and ſurely his wiſdom and benevolence are more conſpicuous when he brings good out of evil, and renders the perverſe wanderings of the human heart ſubſervient to purpoſes of mercy, than when he hurls into the immenſity of ſpace the moſt enormous maſs of dead and paſſive matter ſubjected to unerring laws.

28 The inequalities of Providence accounted for.

As for the inequalities of moral ſituation that are to be obſerved in the world, and the giving to ſome nations and perſons the means of improvement, and the denying them to others, the ſcriptures do indeed aſcribe theſe wholly to the riches and freedom of God's grace. And, we confeſs, that the ways of Providence are often dark and myſterious. In this world there are many things which are hard to be underſtood, and many which appear altogether unaccountable; we ſee the wicked man proſpering in his wickedneſs, though it impoſe miſery upon thouſands; we ſee truth hiding its head, and the world governed by fraud and abſurdity. Still, however, we can venture to aſſert, that God beſtows upon all what is neceſſary to enable them to fulfil the obligations expected from the ſtate in which they are placed; and it is elſewhere ſhown, that phyſical evil is among men the parent of moral good. (See PROVIDENCE). God winketh at the times of ignorance;

much is required of them to whom much is given; and it ſhall be more tolerable in the day of judgment for the inhabitants of Sodom and Gomorrah than for the enlightened cities of Galilee. Thus God will be juſt when he judges; none will meet with condemnation excepting thoſe who are inexcuſable. For although he grants more to ſome than may be abſolutely neceſſary, yet he grants leſs to none; and where he grants little, he will ſuit his judgments to the little which he gave. There is no injuſtice in this. If it was the intention of the great Creator that his creation ſhould contain within its ample boſom every poſſible variety of intelligent natures, it was neceſſary that there ſhould be ſomewhere ſuch a being as man; and, in forming all poſſible varieties of human minds and ſituations, it was neceſſary that every particular individual ſhould exiſt. Hence a man may as well complain that he was not formed one of the flaming ſeraphims that ſurround the throne of the Eternal, as that he is not placed in other circumſtances in life than thoſe which he now occupies; for if little is given, little will be required from him. Thus the deſigns of Providence go on according to the goodneſs and mercy of God. None can complain, though ſome have more cauſe for joy than others. What happens to individuals may happen to nations in a body; ſome may have higher privileges, and be placed in happier circumſtances than others; but none can complain of the wiſe and juſt diſpoſer of all, who has given enough, although we may have good reaſon to complain of ourſelves, for not uſing what was ſufficient.

As to the caſe of thoſe who are not bleſſed with the light of the goſpel, we may conſider, that if they have fewer and leſs advantages than others, their nature and capacities muſt likewiſe be inferior; to which their future ſtate may be proportioned. God is not obliged to make all men equally perfect in the next world any more than in this; and if their capacity be rendered leſs than that of an ordinary *Chriſtian*, a lower degree of happineſs may fill it. However, we need not be extremely ſolicitous about their ſtate, much leſs caſt any ungrateful imputations on the Governor of the world for not having dealt ſo bountifully with them as he has with ourſelves; ſince we know that Chriſt died for the whole race of mankind; that every one will at length be 'accepted according to that he has, and not according to that he has not; and that to whomſoever much is given, of him ſhall much be required' (B).

29 Scriptural expreſſions explained.

Upon theſe principles, we can eaſily explain all the paſſages in the New Teſtament concerning the *purpoſe*, the *election*, the *foreknowledge*, and the *predeſtination* of God. They relate to the deſign of calling the Gentile world to the knowledge of the Meſſias: This was kept ſecret, though hints had been given of it by ſeveral of the prophets, ſo that it was a myſtery; but it was revealed when the apoſtles, in conſequence of Chriſt's commiſſion, *to go and teach all nations*, went about preaching the goſpel to the Gentiles. This was a ſtumbling-block to the Jews, and it was the chief ſubject of diſpute betwixt them and the apoſtles at the time when the Epiſtles were written: ſo that it was neceſſary for them to clear up this point very fully, and to mention it frequently. But in the beginning of Chriſtianity there was no need of amuſing men with high and unſearchable ſpeculations concerning the decrees of God; the apoſtles therefore take up the point in diſpute, the calling of the Gentiles in a general manner. They ſhow, that Abraham at firſt, and Iſaac and Jacob afterwards, were choſen by a diſcriminating favour, that they and their poſterity ſhould be in covenant with God; but that, nevertheleſs, it always was the intention of Providence to call in the Gentiles, though it was not executed till theſe later times.

With this key we can explain coherently the whole of St Paul's diſcourſes upon this ſubject, without aſſerting antecedent and ſpecial decrees as to particular perſons. Things that happen under a permiſſive and directing Providence, may, by a largeneſs of expreſſion, be aſcribed to the will and counſel of God; for a permiſſive will is really a will, though it is not the agent or cauſe of the effect. The *hardening of Pharaoh's heart* may be aſcribed to God, though it is ſaid that his *heart hardened itſelf*, becauſe he took advantage of the reſpites which God granted him from the plagues, to encourage himſelf to longer reſiſtance. Beſides this, he was a cruel and bloody tyrant, and deſerved ſuch judgments for his other ſins; ſo that he may be conſidered as at that time under final condemnation, and only preſerved from the firſt plagues, to afford a ſtriking inſtance of the avenging juſtice of God. That this is the meaning of the paſſage, appears extremely probable from the manner in which Exod. ix. 16. is rendered in the Vatican and Aldus's edit. of the LXX. Inſtead of ſaying, as in our tranſlation, "And in very deed for this cauſe have I *raiſed thee up*, for to ſhow in thee my power, &c." God is repreſented in that verſion as ſaying, "And in very deed for this cauſe have I *kept thee alive till now*, for to ſhow," &c. *Whom he will he hardeneth*, is an expreſſion that can only be applied to ſuch perſons as this tyrant was. It is obvious that the words of our Saviour concerning thoſe *whom his Father had given him*, are only meant of a diſpenſation of Providence, and not of a decree; ſince he adds, And *I have loſt none of them except the ſon of perdition*: for it cannot be ſaid that *Judas Iſcariot* was in the decree, and yet was loſt. And in the ſame paſſage in which God is ſaid *to work in us both to will and to do*, we are required *to work out our own ſalvation with fear and trembling*. The word *ordained* to eternal life alſo ſignifies fitted and diſpoſed to eternal life. The queſtion, *Who made thee to differ?* (1 Cor. iv. 7.) refers to thoſe extraordinary gifts which, in different degrees and meaſures, were beſtowed upon the firſt Chriſtians, in which they were unqueſtionably paſſive.

30 Grace not irreſiſtible.

If the decrees of God are not abſolute, neither can his grace be ſo efficacious as abſolutely and neceſſarily to determine our conduct, elſe why are we required *not to grieve God's ſpirit?* why is it ſaid, *ye do always reſiſt the Holy Ghoſt; as your fathers did, ſo do ye? How*

often

(B) See Biſhop Law's *Conſiderations on the Theory of Religion*, where this queſtion is treated in a very maſterly manner. The work, though leſs known than it ought to be, has great merit, and of the author we have given a biographical ſketch in our ninth volume.

often would I have gathered you under my wings, and ye would not? What could I have done in my vineyard that has not been done in it? Theſe expreſſions indicate a power in us, by which we not only can, but often do, reſiſt the motions of grace. But if the determining efficacy of grace is not acknowledged, it will be much harder to believe that we are efficaciouſly determined to ſin. This ſuppoſition is ſo contrary both to the holineſs of God, and to the whole ſtyle of the ſacred writings, that it is unneceſſary to accumulate proofs of it. *O Iſrael, thou haſt deſtroyed thyſelf, but in me is thy help: ye will not come unto me that ye may have life: Why will you die, O houſe of Iſrael?*

31 The greateſt ſaint on earth may fall.

As for perſeverance, we may remark, that the many promiſes made in the ſacred ſcriptures to them that *overcome*, that continue *ſtedfaſt and faithful to the death*, do certainly inſinuate that a man may fall from a good ſtate. The words of the apoſtle to the Hebrews are very clear and pointed: *For it is impoſſible for thoſe who were once enlightened, and have taſted of the heavenly gift, and were made partakers of the Holy Ghoſt, and have taſted the good word of God, and the powers of the world to come, if they ſhall fall away, to renew them again unto repentance* (Heb. vi. 4.) It is alſo ſaid, *The juſt ſhall live by faith: but if he draw* (c) *back, my ſoul ſhall have no pleaſure in him,* (Heb. x. 38.) and it is ſaid by the prophet, *When the righteous turneth away from his righteouſneſs and committeth iniquity, all his righteouſneſs that he hath done ſhall not be mentioned; in his ſin that he hath ſinned ſhall he die,* (Ezek. viii. 24). Theſe paſſages, with many others, give us every reaſon to believe that a good man may fall from a good ſtate, as well as that a wicked man may turn from a bad one.

32 All difficulties ſolved at the day of judgment.

We conclude the whole by obſerving, that the only difficulty which attends the queſtion ariſes from the myſterious, and apparently partial and unequal, courſe of the divine government in our preſent ſtate; but there is an important day approaching, when God will condeſcend to remove theſe obſcurities, and to vindicate the ways of his providence to man. On that great day, we are well aſſured, that the queſtion will be decided in our favour; for we know that judgment will be given, not according to any abſolute decree, but, according to the deeds which we ourſelves ſhall have freely done in the body, whether they have been good, or whether they have been evil.

Thus have we ſtated, we hope with fairneſs and impartiality, a ſummary of the arguments on both ſides of this long agitated queſtion. We need hardly add, that it is a queſtion involved in conſiderable difficulties.— Milton, who was an eminent philoſopher and divine, as well as the firſt of poets, when he wiſhed to exhibit the fallen angels themſelves as perplexed by queſtions above their comprehenſion, ſet them to diſpute about predeſtination.

They reaſon'd high, of knowledge, will, and fate,
Fixed fate, free-will, fore-knowledge abſolute;
And found no end, in wand'ring mazes loſt.

Paradiſe Loſt.

33 The weak ſide of each doctrine.

The weak ſide of the Calviniſtic doctrine conſiſts in the impoſſibility of reconciling the abſolute and unconditional decree of reprobation with our ideas of the juſtice and goodneſs of God. The weak ſide of the Arminian ſcheme conſiſts in the difficulty of accounting for the certainty of the divine foreknowledge, upon the ſuppoſition of a contingency of events, or an abſolute freedom of will in man.

To elude the former of theſe difficulties, ſome of the late writers upon philoſophical neceſſity, and Dr Prieſtly is among the number, have given up the doctrine of reprobation, and aſſerted, that this world is only a ſtate of preparation for another, in which all men, of every deſcription and character, ſhall attain to final and everlaſting happineſs, when God *ſhall be all, and in all.*— On the other ſide, ſome of the ſupporters of free agency, and Monteſquieu * is among the number, have been diſpoſed to deny the divine attribute of preſcience.

* Lettres Perſ.

Whatever may be thought of the practical tendency of the two opinions, there is one remark which we think ourſelves bound in juſtice to make, although it appears to us to be ſomewhat ſingular. It is this, that from the earlieſt ages down to our own days, if we conſider the character of the ancient Stoics, the Jewiſh Eſſenes, the modern Calviniſts, and Janſeniſts, when compared with that of their antagoniſts the Epicureans, the Sadducees, Arminians, and the Jeſuits, we ſhall find that they have excelled in no ſmall degree in the practice of the moſt rigid and reſpectable virtues, and have been the higheſt honour of their own ages, and the beſt models for imitation to every age ſucceeding. At the ſame time, it muſt be confeſſed, that their virtues have in general been rendered unamiable by a tinge of gloomy and ſevere auſterity.

34 Mutual forbearance recommended.

So far as the ſpeculative foundation of their principles is conſidered, however, neither party ſeems liable to cenſure in a moral point of view. Each of them wiſhes to ſupport, though in a different manner from the other, the honour of the divine character. The Calviniſts begin their argument with the notion of infinite perfection, independency, and abſolute ſovereignty, and thence deduce their opinions; making every difficulty yield to theſe firſt and leading ideas. Their opponents are more jealous of the reſpect due to the divine attributes of juſtice, truth, holineſs, and mercy, and deduce their ſentiments from the idea which they have formed of theſe. Each party lays down general maxims that are admitted by the other, and both argue plauſibly from their firſt principles. Dr Burnet, whom we have here followed very cloſely, juſtly obſerves †, that "theſe are great grounds for mutual charity and forbearance."

† Expoſition of the 39 articles.

PREDETERMINATION, in philoſophy and theology, is that concurrence of God which makes men act, and determines them in all their actions, both good and evil, and is called by the ſchoolmen *phyſical predetermination* or *premotion.* See METAPHYSICS, Part III. Chap. v. and PREDESTINATION.

PREDIAL SLAVES. See *Predial-Slaves.*

(c) In our tranſlation we read, "If *any man* draw back," &c. &c.; but the words *any man* are not in the original; and if they do not make nonſenſe of the text, they muſt at leaſt be acknowledged to obſcure its meaning.

Predial-Tithes, are thoſe that are paid of things ariſing and growing from the ground only; as corn, hay, fruit, &c.

PREDICABLE, among logicians, denotes a general quality which may be predicated, or aſſerted of ſeveral things: thus animal is predicable of mankind, beaſts, birds, fiſhes, &c.

PREDICAMENT, among logicians, the ſame with category. See Category and Philosophy.

PREDICATE, in logic, that which, in a propoſition, is affirmed or denied of the ſubject. In theſe propoſitions, *ſnow is white, ink is not white*; whiteneſs is the predicate which is affirmed of ſnow, and denied of ink.

PRE-EMPTION, a privilege anciently allowed the king's purveyor, of having the choice and firſt buying of corn and other proviſions for the king's houſe; but taken away by the ſtatute 19 Car. II.

PREENING, in natural hiſtory, the action of birds cleaning, compoſing, and dreſſing their feathers, to enable them to glide more eaſily through the air. For this purpoſe they have two peculiar glands on their rump, which ſecrete an unctuous matter into a bag that is perforated, out of which the bird occaſionally draws it with its bill.

1
The Peripatetics maintained the eternity of the world.

PRE-EXISTENCE, a priority of being, or the being of one thing before another. Thus a cauſe, if not in time, is yet in nature pre-exiſtent to its effect. Thus God is pre-exiſtent to the univerſe. Thus a human father is pre-exiſtent to his ſon. The Peripatetics, though they maintained the eternity of the world, were likewiſe dogmatical in their opinion, that the univerſe was formed, actuated, and governed, by a ſovereign intelligence. See *Ariſtotle on the Soul*, and our articles Creation and Earth. See alſo the *Philoſophical Eſſays of Dr Iſaac Watts*, and the *Principles of natural and revealed Religion*, by the Chevalier Ramſey, where the ſubject of the world's eternity is diſcuſſed. Mr Hume's ſpeculations alſo, on this abſtruſe and arduous ſubject, had a greater tendency to diſſipate its gloom than that philoſopher himſelf could imagine.

2
Pre-exiſtence of the ſoul taught by Aſiatic ſages.

3
Socratic arguments for pre-exiſtence refuted.

4
Pre exiſtence taught by Chriſtian Platoniſts.

The pre-exiſtence of the human ſoul to its corporeal vehicle had been from time immemorial a prevailing opinion among the Aſiatic ſages, and from them was perhaps transferred by Pythagoras to the philoſophy of the Greeks; but his metempſychoſis, or tranſmigration of ſouls, is too trivial either to be ſeriouſly propoſed or refuted. Nevertheleſs, from the ſentiments of Socrates concerning the immortality of the ſoul, delivered in his laſt interview with his friends, it is obvious that the tenet of pre-exiſtence was a doctrine of the Platonic ſchool. If at any period of life, ſay theſe philoſophers, you ſhould examine a boy, of how many ideas, of what a number of principles, of what an extent of knowledge, will you find him poſſeſſed: theſe without doubt could neither be ſelf-derived nor recently acquired. With what avidity and promptitude does he attain the knowledge of arts and ſciences, which appear entirely new to him! theſe rapid and ſucceſsful advances in knowledge can only be the effects of reminiſcence, or of a fainter and more indiſtinct ſpecies of recollection. But in all the other operations of memory, we find retroſpective impreſſions attending every object or idea which emerges to her view; nor does ſhe ever ſuggeſt any thought, word, or action, without informing us, in a manner equally clear and evident, that thoſe impreſſions have been made upon our ſenſes, mind, or intellect, on ſome former occaſion. Whoever contemplates her progreſs, will eaſily diſcover, that aſſociation is her moſt faithful and efficacious auxiliary; and that by joining impreſſion with impreſſion, idea with idea, circumſtance with circumſtance, in the order of time, of place, of ſimilarity or diſſimilarity, ſhe is capacitated to accumulate her treaſures and enlarge her province even to an indefinite extent. But when intuitive principles, or ſimple concluſions, are elicited from the puerile underſtanding by a train of eaſy queſtions properly arranged, where is the retroſpective act of memory, by which the boy recogniſes thoſe truths as having formerly been perceived in his mind? Where are the crowds of concomitant, antecedent, or ſubſequent ideas, with which thoſe recollections ought naturally to have been attended? In a word, where is the ſenſe of perſonal identity, which ſeems abſolutely inſeparable from every act of memory? This hypotheſis, therefore, will not ſupport pre-exiſtence. After the Chriſtian religion had been conſiderably diffuſed, and warmly combated by its philoſophical antagoniſts, the ſame doctrine was reſumed and taught at Alexandria, by Platonic proſelytes, not only as a topic conſtituent of their maſter's philoſophy, but as an anſwer to thoſe formidable objections which had been deduced from the doctrine of original ſin, and from the vices which ſtain, and from the calamities which diſturb, human life: hence they ſtrenuouſly aſſerted, that all the human race were either introduced to being prior to Adam, or pre-exiſtent in his perſon; that they were not, therefore, repreſented by our firſt parents, but actually concurred in their crime, and participated their ruin.

5
But no ſolution of original ſin.

The followers of Origen, and ſuch as entertained the notion of Pre-adamites *, might argue from the doctrine of pre-exiſtence with ſome degree of plauſibility. For the human beings introduced by them to the theatre of probation had already attained the capacity or dignity of moral agents; as their crime therefore was voluntary, their puniſhment might be juſt. But thoſe who believe the whole human race created in Adam to be only pre-exiſtent in their germs or ſtamina, were even deprived of this miſerable ſubterfuge; for in theſe homunculi we can neither ſuppoſe the moral nor rational conſtitution unfolded. Since, therefore, their degeneracy was not ſpontaneous, neither could their ſufferings be equitable. Should it be ſaid that the evil of original ſin was penal, as it extended to our firſt parents alone, and merely conſequential as felt by their poſterity, it will be admitted that the diſtinction between penal and conſequential evil may be intelligible in human affairs, where other laws, aſſortments, and combinations than thoſe which are ſimply and purely moral, take place. But that a moral government, at one of the moſt cardinal periods of its adminiſtration, ſhould admit gratuitous or conſequential evil, ſeems to us irreconcileable with the attributes and conduct of a wiſe and juſt legiſlator. Conſequential evil, taken as ſuch, is miſery ſuſtained without demerit; and cannot reſult from the procedure of wiſdom, benignity, and juſtice; but muſt flow from neceſſity, from ignorance, from cruelty, or from caprice, as its only poſſible ſources. But even upon the ſuppoſition of thoſe who pretend that man was mature in all his faculties before the commiſſion of original ſin, the objections againſt it will ſtill remain in full force: for it is admitted by all except the Samian ſage, that the conſciouſneſs of perſonal identity which was felt in the pre-exiſtence, is obliterated in a ſubſequent ſtate of being.

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* See Pre-adamites.

Now it may be demanded, whether agents thus reſuſcitated for puniſhment have not the ſame right to murmur and complain as if they had been perfectly innocent, and only created for that dreadful cataſtrophe? It is upon this principle alone that the effects of puniſhment can be either exemplary or diſciplinary; for how is it poſſible, that the puniſhment of beings unconſcious of a crime ſhould ever be reconciled either to the juſtice or beneficence of that intention with which their ſufferings are inflicted? Or how can others be ſuppoſed to become wiſe and virtuous by the example of thoſe who are neither acquainted with the origin nor the tendency of their miſeries, but have every reaſon to think themſelves afflicted merely for the ſake of afflicting? To us it ſeems clear, that the nature and *rationale* of original ſin lie inſcrutably retired in the boſom of Providence; nor can we, without unpardonable preſumption and arrogance, form the moſt ſimple concluſion, or attempt the minuteſt diſcovery, either different from or extraneous to the clear and obvious ſenſe of revelation. This ſenſe indeed may with propriety be extracted from the whole, or from one paſſage collated with another; but independent of it, as reaſon has no premiſſes, ſhe can form no deductions. The boldneſs and temerity of philoſophy, not ſatisfied with contemplating pre-exiſtence as merely relative to human nature, has dared to try how far it was compatible with the glorious and omniſcient God. The Arians, who allowed the ſubordinate divinity of our Saviour, believed him pre-exiſtent to all time, and before all worlds; but the Socinians, who eſteemed his nature as well as his perſon merely human, inſiſted, that before his incarnation he was only pre-exiſtent in the divine idea, not in nature or perſon. But when it is conſidered, that children do not begin to deduce inſtructions from nature and experience, at a period ſo late as we are apt to imagine; when it is admitted, that their progreſs, though inſenſible, may be much more rapid than we apprehend; when the opportunities of ſenſe, the ardour, of curioſity, the avidity of memory, and the activity of underſtanding, are remarked—we need not have recourſe to a pre-exiſtent ſtate for our account of the knowledge which young minds diſcover. It may likewiſe be added, that moral agents can only be improved and cultivated by moral diſcipline. Such effects therefore of any ſtate, whether happy or miſerable, as are merely mechanical, may be noxious or ſalutary to the patient, but can never enter into any moral economy as parts of its own adminiſtration. Pre-exiſtence, therefore, in this view of it, whether rewarded or puniſhed, without the continued impreſſion of perſonal identity, affords no ſolution of original ſin.

PREFACE, ſomething introductory to a book, to inform the reader of the deſign, method, &c. obſerved therein, and generally whatever is neceſſary to the underſtanding of a book.

PREFECT, in ancient Rome, one of the chief magiſtrates who governed in the abſence of the kings, conſuls, and emperors.

This power was greateſt under the emperors. His chief care was the government of the city, taking cognizance of all crimes committed therein and within 100 miles. He judged capitally and finally, and even preſided in the ſenate. He had the ſuperintendance of the proviſions, building, and navigation.

The prefect of modern Rome differs little from the ancient *præfectus*, his authority only extending to 40 miles round the city.

Prefect *of the Prætorium*, the leader of the pretorian bands deſtined for the emperor's guards, conſiſting, according to Dion, of 10,000 men. This officer, according to Suetonius, was inſtituted by Auguſtus, and uſually taken from among the knights.

By the favour of the emperors his power grew very conſiderable; to reduce which, Conſtantine divided the prefecture of the prætorium into four prefectures, and each of theſe again he ſubdivided into civil and military departments, though the name was only reſerved to him who was inveſted with the civil authority, and that of *comes belli* given him who commanded the cohorts.

PREGADI, in hiſtory, a denomination given to the ſenate of Venice, in which reſides the whole authority of the republic. At its firſt inſtitution it was compoſed of 60 ſenators, to whom 60 more have been added. See Venice.

PREGNANCY, the ſtate of a woman who has conceived, or is with child. See Midwifery.

PREHNITE, a ſtone ſo named by Mr Werner, inſpector of the mines of Freyburg, brought by Colonel Prehn from the Cape of Good Hope. In the firſt volume of *Chemical Annals* there is a chemical analyſis of this ſtone extracted from the *Acta Naturæ Curioſorum*, Berlin, tom. viii. p. 211. an. 1788, part 2. by Klaproth; from which it appears, that 100 parts of prehnite contain

ſilice - -	43 5/6 grains.
Alumine - -	30 1/3
Lime - -	18 1/3
Oxyd of iron - -	5 2/3
Water and air - -	1 1/6
Total -	100

Colonel Prehn gave it the name of emerald, and Mr Bruckmann adopted that denomination, but changed his opinion on conſidering that it had neither the hardneſs, the bright green colour, nor the property of cryſtallizing in hexagonal priſms like the emerald. The Dutch dealers call it *chryſopraſus* of the Cape; but chryſopraſus is nothing but quartz tinged green by the oxyd of nickel. Profeſſor Haquet, in the 4th volume of the Berlin Tranſactions, has named it *cryſtallized praſus*. In the 8th volume, however, Mr Bruckmann conſiders it as a cryſtallized felt-ſpar. Mr Sage calls it *chryſolite*. Mr Rome de l'Iſle claſſes it among the ſchoerls. To this claſſification Mr Klaproth objects, and is rather diſpoſed with Mr Werner to conſider it as a zeolite; on the whole, he thinks it may be conveniently ranked between zeolite and ſchoerl. Mr Haſſenfratz publiſhed in the *Journal de Phyſique* for February 1788 an analyſis of the ſame ſtone, under the title of *Pierre Silice, calcaire, alumineuſe, &c. &c. de couleur verte, &c.* And according to his reſults, which are ſomewhat different from thoſe of Mr Klaproth, and obtained by a different proceſs, it contains, ſilice 50, lime 23.4, alumine 20.4, oxyd of iron 4.9, water 0.9, magneſia 0.5=100. The ſpecific gravity of this ſtone, according to the experiments of Mr Briſſon, is 2.9423. The diſſection of its cryſtals, made by Abbé Haüy and Mr Haſſenfratz, diſcovered one angle of 60 degrees, as in ſchoerls; but it has hitherto been impoſſible to determine the others. The Abbé Haüy has convinced himſelf, that it bears no reſemblance to zeolite in its cryſtals. This ſtone ſcratches glaſs, and is itſelf ſcratched by rock cryſtal.

1 Definition.

PREJUDICE, or PREJUDGMENT, from *præ* and *judicium*, means a judgment formed beforehand, without examination; the prepoſition *præ* expreſſing an anticipation, not ſo much of time as of knowledge and due attention: thence the ſchoolmen have called it *anticipation and a preconceived opinion*.

2 Origin of prejudice.

Prejudice ariſes from the aſſociating principle, which we have explained at large in another article (ſee METAPHYSICS, Part I. chap. 5.), and it is a weakneſs from which no human mind can be wholly free. Some are indeed much more than others under its influence; but there is no man who does not occaſionally act upon principles, the propriety of which he never inveſtigated; or who does not hold ſpeculative opinions, into the truth of which he never ſeriouſly inquired. Our parents and tutors, yea our very nurſes, determine a multitude of our ſentiments: our friends, our neighbours, the cuſtom of the country where we dwell, and the eſtabliſhed opinions of mankind, form our belief; the great, the pious, the learned, and the ancient, the king, the prieſt, and the philoſopher, are characters of mighty efficacy to perſuade us to regulate our conduct by their practice, and to receive as truth whatever they may dictate.

The caſe cannot indeed be otherwiſe. The occaſions of acting are ſo frequent, and the principles of action are ſo various, that were a man to inveſtigate accurately the value of every ſingle motive which preſents itſelf to his mind, and to balance them fairly againſt each other, the time of acting would in moſt inſtances paſs away long before he could determine what ought to be done; and life would be waſted in uſeleſs ſpeculation. The great laws of religion and morality, which ought to be the general and leading principles of action, no man of ſcience will take upon truſt; but in the courſe of a buſy life a thouſand circumſtances will occur in which we muſt act with ſuch rapidity, that, after being ſatisfied of the lawfulneſs of what we are about to do, we muſt, for the prudence of it, confide entirely in the general cuſtoms of our country, or in the practice of other individuals placed in circumſtances ſimilar to ours. In all ſuch caſes, though we may act properly, we act from *prejudice*.

3 Its extenſive dominion.

But the dominion of prejudice is not confined to the actions of the man of buſineſs: it extends over the ſpeculations of the philoſopher himſelf, one half of whoſe knowledge reſts upon no other foundation. All human ſciences are related to each other (ſee PHILOSOPHY, n° 2.), and there is hardly one of them in which a man can become eminent unleſs he has ſome general acquaintance with the whole circle; but no man could ever yet inveſtigate for himſelf all thoſe propoſitions which conſtitute the circle of the ſciences, or even comprehend the evidence upon which they reſt, though he admits them perhaps as truths uncontrovertible. He muſt therefore receive many of them upon the authority of others, or, which is the ſame thing, admit them by *prejudice*.

To this reaſoning it may be objected, that when a man admits as true abſtract propoſitions, which, though not ſelf-evident, he cannot demonſtrate, he admits them not by prejudice, but upon teſtimony, which has been elſewhere ſhown to be a ſufficient foundation for human belief (ſee METAPHYSICS, n° 138.) The objection is plauſible, but it is not ſolid; for teſtimony *commands* belief only concerning *events* which, falling under the cognizance of the ſenſes, preclude all poſſibility of miſtake; whereas abſtract propoſitions, not ſelf-evident, can be proved true only by a *proceſs of reaſoning* or by a *ſeries of experiments;* and in conducting both theſe, the moſt vigorous mind is liable to miſtake. When Sir Iſaac Newton told the world that it was the fall of an apple which firſt ſuggeſted to him the general law of gravitation, he bore teſtimony to a fact concerning which he could not be miſtaken; and we receive his teſtimony for the reaſons aſſigned in the article referred to. When he lays down the method of obtaining the fluxion or momentum of the rectangle or product of two indeterminate quantities, which is the main point in his doctrine of fluxions, he labours to eſtabliſh that method on the baſis of demonſtration; and whoever makes uſe of it in practice, without underſtanding that demonſtration, receives the whole doctrine of the modern geometrical analyſis, not as a matter of *fact* upon the credit of Sir Iſaac's *teſtimony*, but as a ſyſtem of abſtract *truth* on the credit of his *underſtanding:* in other words, he is a fluxioniſt by *prejudice*.

In vain will it be ſaid, that in mathematical demonſtration there is no room for miſtake; and that therefore the man who implicitly adopts the method of fluxions may be conſidered as relying upon the *veracity* of its author, who had no inducement to deceive him, and whoſe comprehenſion was confeſſedly greater than his. In fluxionary mathematics, which treat of matters of which it is extremely difficult, if not impoſſible, to have adequate and ſteady conceptions, the moſt comprehenſive mind is liable to miſtake: and it is well known that the celebrated biſhop of Cloyne wrote his *Analyſt* to prove that the incomparable author of the method of fluxions had committed *two miſtakes* in his fundamental propoſition, which balancing one another, produced a true concluſion by falſe reaſoning. One or other of theſe great men, of whom the leaſt was an eminent mathematician, muſt have been bewildered in his reaſoning, and have fallen into error; and therefore whoever follows either of them implicitly without perceiving the error of the other, is unqueſtionably under the influence of prejudice. This is the caſe with the writer of the preſent article. He perceives not the error of Biſhop Berkeley's reaſoning, and yet he admits the doctrine of fluxions on the authority of Sir Iſaac's demonſtration. That demonſtration, however, he pretends not to underſtand; and therefore he admits the doctrine through *prejudice*.

4 Impoſſible to eradicate all prejudices from the mind.

We have made theſe obſervations to point out the abſurdity of the faſhionable cry againſt the harbouring of any prejudices. To eradicate all prejudices from the human mind is impoſſible; and if it were poſſible, it would be very unwiſe: for we ſee that prejudice may exiſt on the ſide of truth as well as on that of falſehood; and that principles profeſſed and believed by any individual may be uſeful and true, though he was brought to them not by a train of fair and candid reaſoning, but through the medium of prepoſſeſſion or authority. Indeed ſuch is our nature, and ſuch are the laws of aſſociation,

ſociation, that many of our beſt principles, and our obligation to perform many of the moſt amiable of our duties in common life, muſt evidently be acquired in this way. From endearing aſſociations, and authoritative inſtruction, we acquire a knowledge of our duty to our parents, and a facility in performing it, together with the firſt principles of religion, without a ſingle effort of our own reaſon. Even when reaſon has begun to aſſert its power, and ſhows us the propriety of ſuch duties, we are wonderfully aſſiſted in performing them by the amiable prejudices which we had before acquired, and which now appear to be natural to us. He who has never had the advantage of ſuch aſſociations, and who acquires a knowledge of the duties ſuggeſted by them after he has come to years of diſcretion, and chiefly by the efforts of his own reaſon, will ſeldom, *cæteris paribus*, perform thoſe duties with an energy and delight equal to that of the perſon who has. This remark appears to be confirmed by experience; for it is often found, that the children of the great, who have been given out to nurſe in their infancy, and who have ſeldom been in the company of their parents till their reaſoning faculties have been far advanced, are much leſs dutiful and affectionate than thoſe in the middle or lower ſtations of life, who have ſcarcely ever been out of their parents company.

5 Which would not be wiſe if it were poſſible.

Would it then be wiſe, even if it were practicable, to diſſolve all thoſe aſſociations which tend ſo powerfully to increaſe the mutual affections of parents and children? We cannot think that it would; as we believe it might be eaſily ſhown that public ſpirit ſprings out of private affection. Plato indeed held an opinion very different from ours; for in order to extend that affection which is uſually laviſhed at home to the whole ſtate, he propoſed that children ſhould be educated at the public expence, and never be permitted to know the authors of their being. But this is only one of the many viſionary projects of that great man, of which daily experience ſhows the abſurdity. In modern times, we are certain that leſs dependence is to be had upon the *patriotiſm* of the man who, for the love which he pretends to his country, can overlook or forget his own partial connections in it, than on him who, at the ſame time that he wiſhes his country well, is feelingly alive to all the endearments of kindred affection.

6 Good effects of ſome prejudices.

Such affection may be called *partial*, and very probably has its foundation in that which is the ſource of all our prejudices: but if it be properly trained in early life, it will gradually extend from our neareſt relations to the perſons with whom we aſſociate, and to the place which not only gave us birth, but alſo furniſhed our youthful and moſt innocent enjoyments. It is thus that the *amor patriæ* is generated (ſee Passion and Patriotism), which in minds unſeduced by falſe principles is exceedingly ſtrong; and though a partial affection, is of the moſt general utility. It is this prejudice which reconciles the Laplander to his freezing ſnows, and the African to his burning ſun; which attaches the native of the Highlands or of Wales as much to his mountains and rocks, as the apparently happier inhabitant of the ſouthern counties of England is to the more fertile and delightful ſpot where he drew his firſt breath. And we find in fact, that when a native of Kent and a Scotch Highlander have in ſome diſtant corner of the world gained a competent fortune without being corrupted by luxury, they return, the one to his hop-gardens, and the other to his mountains. Were this prejudice, for ſuch it ſurely is, wholly eradicated from the human mind, it is obvious that large tracts of country which are now full of inhabitants would be totally deſerted; and that the hungry barbarians, to make room for themſelves, would exterminate the proprietors of more favourable climes. From an affection to our friends and to our country, we naturally contract an affection for that mode of government under which we live; and unleſs it be particularly oppreſſive to ourſelves or any order of citizens, we come as naturally to prefer it to all other modes, whether it deſerve that preference or not. This no doubt is prejudice, but it is a beneficial prejudice; for were the multitude, who are wholly incapable of eſtimating the excellencies and defects of the various modes of government, to become diſſatisfied with their own, and riſe in a maſs to change it for the better, the moſt horrible conſequences might juſtly be dreaded. Of this truth the preſent ſtate of Europe affords too melancholy and convincing a proof. The man therefore who, under the pretence of enlightening the public mind and extirpating prejudices, paints to the illiterate vulgar, in aggravated colours, the abuſe of that government which has hitherto protected them from the ferocity of each other, is one of the greateſt criminals if his views be ſelfiſh, and one of the worſt reaſoners if they be diſintereſted, that human imagination can eaſily conceive.

7 Danger of improper attempts to remove them.

With the ſelfiſh patriot we have at preſent no concern: but we may with propriety aſk the diſintereſted lover of truth, whether he thinks it poſſible, that in a large community, of which nine-tenths of the members are neceſſarily incapable of taking comprehenſive views of things, or feeling the force of political reaſonings, any form of government can be acceptable to the people at large, which does not gain their affections through the medium of prejudice? It has been ſhown by Mr Hume with great ſtrength of argument, that government is founded on *opinion*, which is of two kinds, viz. opinion of intereſt, and opinion of right. By opinion of intereſt, he underſtands the ſenſe of the general advantage which is reaped from government, together with the perſuaſion that the particular government which is eſtabliſhed is equally advantageous with any other that could eaſily be ſettled. The opinion entertained of the *right* of any government is always founded in its antiquity; and hence ariſes the paſſionate regard which under ancient monarchies the people have for the true heir of their royal family. Theſe opinions, as held by the philoſopher converſant with the hiſtory of nations, are founded upon reaſoning more or leſs concluſive; but it is obvious, that in the minds of the multitude they can have no other foundation than prejudice. An illiterate clown or mechanic does not *ſee how* one form of government promotes the general intereſt more than another; but he may *believe* that it does, upon no other evidence than the declamation of a demagogue, who, for ſelfiſh purpoſes, contrives to flatter his pride. The ſame is the caſe with reſpect to the rights of hereditary monarchy. The anatomiſt finds nothing more in the greateſt monarch than the meaneſt peaſant, and the moraliſt may perhaps frequently find leſs; but the true philoſopher acknowledges his right to the ſovereignty: and though he be weak in underſtanding, or infirm in years, would, for the ſake of public peace and the ſtability of government, maintain him in his throne againſt every competitor of the moſt ſhining talents. The vulgar, however, who would act with this philoſopher, are influenced by no ſuch views, but merely by their prejudices in favour of birth and family; and therefore it is ridiculous to think of changing the public mind with reſpect to any form of government by pure reaſoning. In France a total change in the minds of the people has indeed been effected, and from the moſt violent prejudices in favour of royalty, they have now become more violently prejudiced in favour of republicaniſm. Bad as their government unqueſtionably was, the change that has now taken place is not the effect of calm reaſoning and accurate inquiry (for of that the bulk of mankind appears to be incapable), nor are their prejudices leſs violent than they were before. They are changed indeed; but no one will deny that prejudice, and that of the moſt violent kind, leads them on at preſent; nor can any one aſſert that their new prejudices have rendered them more happy, or their country more flouriſhing, than their former ones, which made them cry *Vive le Roi* under the tyrannic government of Louis XIV.

The influence of prejudice is not more powerful in fixing the political opinions of men, than in dictating their religious creed. Every child of a religious father receives his faith by inheritance long before he be capable of judging whether it be agreeable or diſagreeable to the word of God and the light of reaſon. This experience ſhows to be the fact; and ſound philoſophy declares that it cannot be otherwiſe. Parents are appointed to judge for their children in their younger years, and to inſtruct them in what they ſhould believe, and what they ſhould practiſe in the civil and religious life. This is a dictate of nature, and doubtleſs would have been ſo in a ſtate of perfect innocence. It is impoſſible that children ſhould be capable of judging for themſelves before their minds are furniſhed with a competent number of ideas, and before they are acquainted with any *principles* and *rules* of juſt reaſoning; and therefore they can do nothing better than run to their parents, and receive their directions what they ſhould believe and what they ſhould practiſe.

8
Abſurdity of keeping children ignorant of religion from the dread of prejudice.

This mode of tutoring the infant mind, and giving to our inſtructions the force of prejudice, before reaſon can operate with much effect, will, we know, be highly diſpleaſing to many who challenge to themſelves alone the epithet of liberal. With them it will be cramping the genius and perverting the judgment: but we cannot help thinking that ſuch an objection, if it ſhould be made, would be the offspring of ignorance; for it requires but very little knowledge of human nature to be able to ſee, that if children be not reſtrained by authority, and if we do not inſinuate a love of good principles into their minds, bad ones will inſinuate themſelves, and a little time will give *them* the force of inveterate prejudice, which all the future efforts of reaſon and philoſophy will find it difficult to eradicate. The idea of keeping a child ignorant of the being of a God, and the grand duties of morality and religion, till he ſhall come to years of diſcretion, and then allowing him to reaſon them out for himſelf, is an abſurd chimera: it is an experiment which never has been tried, which to us it appears impoſſible to try, and which, if it could be tried, could not poſſibly produce any good effect. For ſuppoſe we had a youth juſt arrived at years of diſcretion, totally ignorant of all theſe things, and unbiaſſed to any ſyſtem of opinions, or rather poſſeſſed of no opinions at all—it would, in the firſt place, we ſuſpect, be abſolutely neceſſary to direct his thoughts into a particular train, and for ſome perſon to lead him on from one idea to another, till he ſhould arrive at ſome concluſion: but in all this there is the influence of authority, aſſociation, and of prejudice.

9
Origin of bigotry.

It being therefore abſolutely neceſſary that ſentiments of religion be inſtilled into the minds of children before they be capable of diſcovering by the uſe of their reaſon whether thoſe ſentiments be juſt or not, it need not excite wonder, nor is it any reflection upon religion, that moſt men adhere with bigotry to the creed of their fathers, and ſupport that creed by arguments which could carry conviction to no minds but their own. The love and veneration which they bear to the memory of thoſe from whom they imbibed their earlieſt opinions, do not permit them to perceive either the falſehood of thoſe opinions, or their little importance, ſuppoſing them true. Hence the many frivolous diſputes which have been carried on amongſt Chriſtians; and hence the zeal with which ſome of them maintain tenets which are at once contrary to ſcripture, to reaſon, and to common ſenſe. A due reflection, however, on the ſource of all prejudices ought to moderate this zeal; for no man is wholly free from that bias which he is ſo ready to condemn in others: and indeed a man *totally free from prejudice*, would be a more unhappy being than the moſt violent bigot on earth. In ſcience, he would admit nothing which he could not himſelf demonſtrate; in buſineſs, he would be perpetually at a ſtand for want of motives to influence his conduct: he could have no attachment to a particular country; and therefore muſt be without patriotiſm, and without the ſolaces of friendſhip; and his religion, we are afraid, would be cold and lifeleſs.

10
An objection anſwered.

What, it will be ſaid, are the authors of a work which profeſſes to enlighten the public mind by laying before it a general view of ſcience and literature, become at laſt the advocates of *prejudice*, which is the *bane* of *ſcience*, and the *prop* of *ſuperſtition?* No, we are advocates for no prejudice which is either inimical to ſcience or friendly to abſurdity; but we do not think that the moraliſt would act wiſely who ſhould deſert his proper buſineſs to make himſelf maſter of the higher mathematics, merely that he might not be obliged to truſt occaſionally to the demonſtrations of others. The writer of this article is not ſkilled in trade; but it is not his opinion that the merchant would ſoon grow rich, who ſhould never make a bargain till he had previouſly calculated with mathematical exactneſs all the probabilities of his gain or loſs. That to diſſolve all the aſſociations which are the ſource of partial attachments of kindred, affection, and private friendſhip, would tend to promote the public happineſs, we cannot poſſibly believe. And whether or not the experience of the preſent day confirms Mr Hume's opinion, that far from endeavouring to extirpate the people's prejudices in favour of birth and family, we ſhould cheriſh ſuch ſentiments, as being abſolutely requiſite to preſerve a due ſubordination in ſociety, we pretend not to determine; but that men ſhould be better Chriſtians if they were to receive no religious inſtruction till they ſhould be able by their own reaſon to judge of its truth, daily obſervation does not warrant us to conclude; for we ſee thoſe who have ſeldom heard of God when children, "live without him in the world" when they are men.

Pernicious prejudices we have traced to their ſource elſewhere, and ſhown how they may be beſt prevented by proper attention in the education of children. See METAPHYSICS, nº 98). We ſhall only add here, that the earlier ſuch attention is paid, the more effectual it will be found; and that it is much eaſier to keep prejudices out of the mind than to remove them after they have been admitted. This however muſt be ſometimes attempted; and where prejudices are ſtrong, ſeveral methods have been recommended for rendering the attempt ſucceſsful. The following are taken moſtly from Dr Watts's improvement of the mind.

11
Proper methods of removing prejudices.

1. Never attack the prejudice *directly*, but lead the perſon who is under its influence ſtep by ſtep to the truth. Perhaps your neighbour is under the influence of *ſuperſtition and bigotry in the ſimplicity of his ſoul*; you muſt not immediately run upon him with violence, and ſhow him the abſurdity or folly of his own opinions, though you might be able to ſet them in a glaring light; but you muſt rather begin at a diſtance, and eſtabliſh his aſſent to ſome familiar and eaſy propoſitions, which have a tendency to refute his miſtakes, and to confirm the truth; and then ſilently obſerve what impreſſion this makes upon him, and proceed by ſlow degrees as he is able to bear, and you muſt carry on the work perhaps at diſtant ſeaſons of converſation. The tender or diſeaſed eye cannot bear a deluge of light at once.

Overhaſtineſs and vehemence in arguing is oftentimes the effect of *pride*; it blunts the poignancy of the argument, breaks its force, and diſappoints the end. If you were to convince a perſon of the falſehood of the *doctrine of tranſubſtantiation*, and you take up the conſecrated bread before him and ſay, "You may ſee, and taſte, and feel, *this is nothing but bread*; therefore whilſt you aſſert that God commands you to believe *it is not bread*, you moſt wickedly accuſe God of commanding you to tell a lie." This ſort of language would only raiſe the indignation of the perſon againſt you, inſtead of making any impreſſions upon him. He will not ſo much as think at all on the argument you have brought, but he rages at you as a *profane wretch*, ſetting up your own ſenſe and reaſon above ſacred authority; ſo that though what you affirm is a truth of great evidence, yet you loſe the benefit of your whole argument by an ill management, and the unreaſonable uſe of it.

2. Where the prejudices of mankind cannot be conquered at once, but will riſe up in arms againſt the evidence of truth, there we muſt make ſome allowances, and yield to them for the preſent, as far as we can ſafely do it without real injury to truth; and if we would have any ſucceſs in our endeavours to convince the world, we muſt practiſe this complaiſance for the benefit of mankind. Take a ſtudent who has deeply imbibed the principles of the *Peripatetics*, and imagines certain immaterial beings, called *ſubſtantial forms* to inhabit every herb, flower, mineral, metal, fire, water, &c. and to be the ſpring of all its properties and operations; or take a Platoniſt, who believes an *anima mundi*, "an univerſal ſoul of the world," to pervade all bodies, to act in and by them according to their nature, and indeed to give them their nature and their ſpecial powers; perhaps it may be very hard to convince theſe perſons by arguments, and conſtrain them to yield up thoſe fancies. Well then, let the one believe his *univerſal ſoul*, and the other go on with his notion of *ſubſtantial forms*, and at the ſame time teach them how by certain original laws of motion, and the various ſizes, ſhapes, and ſituations of the parts of matter, allowing a continued divine concourſe in and with all, the ſeveral appearances in nature may be ſolved, and the variety of effects produced, according to the corpuſcular philoſophy, improved by *Deſcartes*, *Mr Boyle*, and *Sir Iſaac Newton*; and when they have attained a degree of ſkill in this ſcience, they will ſee theſe airy notions of theirs, theſe imaginary powers, to be ſo uſeleſs and unneceſſary, that they will drop them of their own accord. The *Peripatetic forms* will vaniſh from the mind like a dream, and the *Platonic ſoul of the world will expire*.

We may give another inſtance of the ſame practice, where there is a prejudicate fondneſs of particular words and phraſes. Suppoſe a man is educated in an *unhappy form of ſpeech*, whereby he explains ſome *great doctrine of the goſpel*, and by the means of this phraſe he has imbibed a very falſe idea of that doctrine; yet he is ſo bigotted to his form of words, that he imagines if thoſe words are omitted the form is loſt. Now, if we cannot poſſibly perſuade him to part with his improper terms, we will indulge them a little, and try to explain them in a ſcriptural ſenſe, rather than let him go on in his miſtaken ideas. A perſon who has been bred a *Papiſt*, knows but little of religion, yet he reſolves never to depart from the *Roman Catholic faith*, and is obſtinately bent againſt a change. Now it cannot be unlawful to teach ſuch an one the true Chriſtian, *i. e.* the *Proteſtant religion*, out of the *Epiſtle to the Romans*, and ſhow him that the ſame doctrine is contained in the *Catholic Epiſtles of St Peter, James, and Jude*; and thus let him live and die a good Chriſtian in the belief of the religion taught him out of the New Teſtament, while he imagines he is a *Roman Catholic* ſtill, becauſe he finds the doctrine he is taught in the *Catholic* Epiſtles and in that to the *Romans*. Sometimes we may make uſe of the very prejudices under which a perſon labours, in order to convince him of ſome particular truth, and argue with him upon his own profeſſed principles as though they were true. Suppoſe a *Jew* lies ſick of a fever, and is forbid fleſh by his phyſician; but hearing that rabbits were provided for the dinner of the family, deſired earneſtly to eat of them; and ſuppoſe he became impatient, becauſe his phyſician did not permit him, and he inſiſted upon it that it could do him no hurt—ſurely rather than let him perſiſt in that fancy and that deſire, to the danger of his life, we might tell him that theſe animals were ſtrangled, a ſort of food forbidden by the Jewiſh law, though we ourſelves might believe that law to be aboliſhed.

Where we find any perſon obſtinately perſiſting in a miſtake in oppoſition to all reaſon, eſpecially if the miſtake be very injurious or pernicious, and we know this perſon will hearken to the ſentiment or authority of ſome favourite name; it is needful ſometimes to urge the *opinion and authority* of that favourite perſon, ſince that is likely to be regarded much more than *reaſon*. We are almoſt aſhamed indeed to ſpeak of uſing any *influence of authority* in reaſoning or argument; but in ſome caſes it is better that poor, ſilly, perverſe, obſtinate creatures, ſhould be perſuaded to judge and act right, by a veneration for the ſenſe of others, than to be left to wander in pernicious errors, and continue deaf to all argument, and blind to all evidence. They are but children of a larger ſize; and ſince they perſiſt all their lives in their minority, and reject all true reaſoning, ſurely we may try to perſuade them to practiſe what is for their own intereſt by ſuch childiſh reaſons as they will hearken to. We may overaw them from purſuing their own ruin by the terrors of a ſolemn ſhadow, or allure them by a ſugar plum to their own happineſs. But after all, we muſt conclude, that whereſoever it can be done, it is beſt to *remove and root out thoſe prejudices* which obſtruct the entrance of truth into the mind, rather than to palliate, humour, or indulge them; and ſometimes this muſt neceſſarily be done, before you can make a perſon part with ſome beloved error, and lead him into better ſentiments.

12 Mutual forbearance recommended.

On the whole, we would recommend more mutual forbearance and leſs acrimony than is commonly found among writers on diſputed ſubjects, as the only means by which our differences in religion, politics, and ſcience, ever can be healed, and truth certainly diſcovered. If men were leſs violent in defending their particular opinions, they would always gain a more patient hearing, they would be leſs ſuſpected of, and leſs liable to, prejudice, and of courſe more apt either to convince or to be convinced. They would likewiſe by ſo doing ſhow, in the moſt unequivocal manner, their attention to ſound philoſophy, and above all to genuine Chriſtianity; which, though it is far from encouraging ſcepticiſm, or a temporizing ſpirit, recommends, in the ſtrongeſt terms, among all its profeſſors, *univerſal charity and mutual forbearance*. See PROBABILITY, TRUTH, and SUPERSTITION.

PRELATE, an eccleſiaſtic raiſed to ſome eminent and ſuperior dignity in the church; as biſhops, archbiſhops, patriarchs, &c.

PRELIMINARY, in general, denotes ſomething to be examined and determined before an affair can be treated of to the purpoſe.

PRELUDE, in muſic, is uſually a flouriſh or irregular air, which a muſician plays off-hand, to try if his inſtrument be in tune, and ſo lead him into the piece to be played.

PREMISSES, in logic, an appellation given to the two firſt propoſitions of a ſyllogiſm. See LOGIC.

PREMISSES, in law, properly ſignifies the land, &c. mentioned in the beginning of a deed.

PREMIUM, or PRÆMIUM, properly ſignifies a reward or recompenſe: but it is chiefly uſed in a mercantile ſenſe for the ſum of money given to an inſurer, whether of ſhips, houſes, lives, &c. See INSURANCE.

PREMNA, in botany; a genus of the angioſpermia order, belonging to the didynamia claſs of plants. The calyx is bilobed; the corolla quadrifid; the berry quadrilocular; the ſeeds ſolitary.

PREMONSTRANTES, or PRÆMONSTRATENSES, a religious order of regular canons inſtituted in 1120, by S. Norbert; and thence alſo called *Norbertines*.

The firſt monaſtery of this order was built by Norbert in the Iſle of France, three leagues to the weſt of Laon; which he called *Præmonſtre*, *Præmonſtratum*, and hence the order itſelf derived its name; though as to the occaſion of that name, the writers of that order are divided. At firſt the religious of this order were ſo very poor, that they had only a ſingle aſs, which ſerved to carry the wood they cut down every morning, and ſent to Laon in order to purchaſe bread. But they ſoon received ſo many donations, and built ſo many monaſteries, that in 30 years after the foundation of the order, they had above 100 abbeys in France and Germany: and in proceſs of time the order ſo increaſed, that it had monaſteries in all parts of Chriſtendom, amounting to 1000 abbeys, 300 provoſtſhips, a vaſt number of priories, and 500 nunneries. But they are now greatly diminiſhed. The rule they followed was that of St Auguſtine, with ſome ſlight alterations, and an addition of certain ſevere laws, whoſe authority did not long ſurvive their founder.

The order was approved by Honorius II. in 1126, and again by ſeveral ſucceeding popes. At firſt the abſtinence from fleſh was rigidly obſerved. In 1245 Innocent IV. complained of its being neglected to a general chapter. In 1288, their general, William, procured leave of pope Nicholas IV. for thoſe of the order to eat fleſh on journeys. In 1460, Pius II. granted them a general permiſſion to eat meat, excepting from Septuageſima to Eaſter. The dreſs of the religious of this order is white, with a ſcapulary before the caſſock. Out of doors they wear a white cloak and white hat; within, a little camail; and at church, a ſurplice, &c.

In the firſt monaſteries built by Norbert, there was one for men and another for women, only ſeparated by a wall. In 1137, by a decree of a general chapter, this practice was prohibited, and the women removed out of thoſe already built, to a greater diſtance from thoſe of the men.

The Præmonſtratenſes, or monks of Premontre, vulgarly called *white canons*, came firſt into England, A. D. 1146. Their firſt monaſtery, called *New-houſe*, was erected in Lincolnſhire, by Peter de Saulia, and dedicated to St Martial. In the reign of Edward I. this order had 27 monaſteries in England.

PRENANTHES, in botany: A genus of the polygamia æqualis order, belonging to the ſyngeneſia claſs of plants; and in the natural method ranking under the 49th order, *Compoſitæ*. The receptacle is naked; the calyx calyculated; the pappus is ſimple, and almoſt ſeſſile; the florets are placed in a ſingle ſeries.

PRENOMEN, PRÆNOMEN, among the ancient Romans, a name prefixed to their family name, and anſwering to our Chriſtian name: ſuch are Caius, Lucius, Marcus, &c.

PRENOTION, PRÆNOTIO, or *Præcognitio*, is a notice or piece of knowledge preceding ſome other in reſpect of time. Such is the knowledge of the antecedent, which muſt precede that of the concluſion. It is uſed by Lord Bacon for breaking of an endleſs ſearch, which he obſerves to be one of the principal parts of the art of memory. For when one endeavours to call any thing to mind, without ſome previous notion or perception of what is ſought for, the mind exerts itſelf and ſtrives in an endleſs manner: but if it hath any ſhort notion before-hand, the infinity of the ſearch is preſently cut off, and the mind hunts nearer home, as in an incloſure. Thus verſe is eaſier remembered than proſe; becauſe if we ſtick at any word in a verſe, we have a previous notion that it is ſuch a word as muſt ſtand in a verſe. Hence alſo, order is a manifeſt help to memory; for here is a previous notion, that the thing ſought for muſt be agreeable to order. Bacon's *Works Abr.* vol. i. p. 136. and vol. ii. p. 473.

PREPARATION, in a general ſenſe, the act of diſpoſing things in ſuch a manner as to render any foreſeen event more advantageous or leſs hurtful according to its nature.

PREPARATION *of Diſſonances*, in muſic, is their diſpoſition in harmony in ſuch a manner, that, by ſomething congenial in what precedes, they may be rendered leſs harſh to the ear than they would be without that precaution; according to this definition, every diſcord ought to be prepared. But when, in order to prepare a diſſonance, it is exacted that the ſound which forms it ſhould before have formed a conſonance, then there is fundamentally but one ſingle diſſonance which is prepared, viz. the ſeventh. Nor is even this preparation neceſſary in the chord which contains the ſenſible note, becauſe then the diſſonance being characteriſtical, both in its chord and in its mode, the ear has ſufficient reaſon to expect it: it accordingly does expect it, and recogniſe it; nor is either deceived with reſpect to its chord nor its natural progreſs. But when the ſeventh is heard upon a fundamental ſound which is not eſſential to the mode, it ought then to be prepared, in order to prevent all ambiguity; to prevent the ear, whilſt liſtening to this note, from loſing its train: and as this chord of the ſeventh may be inverted and combined in ſeveral different manners, from this ariſe likewiſe a number of different ways by which it may ſeem to be prepared, which, in the main, always iſſue however in the ſame thing.

In making uſe of diſſonances, three things are to be conſidered; viz. the chord which precedes the diſſonance, that in which it is found, and that which is immediately ſubſequent to it. Preparation only reſpects the two firſt; for the third ſee RESOLUTION.

When we would regularly prepare a diſcord in order to arrive at its chord, we muſt chooſe ſuch a career of the fundamental baſs, that the ſound which forms the diſſonance may be a protraction into the perfect time of the ſame note which formed a conſonance formerly ſtruck in the imperfect in the preceding chord; this is what we call *ſincopation*. See SINCOPATION.

From this preparation two advantages reſult; viz. 1. That there is neceſſarily an harmonical connection between the two chords, ſince that connection is formed by the diſſonance itſelf; and, 2. That this diſſonance, as it is nothing elſe but the continuation of the ſame ſound which had formed a conſonance, becomes much leſs harſh to the ear than it would have been with any ſound recently ſtruck. Now this is all that we expect to gain by preparation. See CADENCE, DISCORD, and HARMONY.

By what has been juſt ſaid, it will appear that there is no other part peculiarly deſtined for preparing the diſſonance, except that in which it is heard; ſo that if the treble ſhall exhibit a diſſonance, that muſt be ſincopated; but if the diſſonance is in the baſs, the baſs muſt be ſincopated. Though there is nothing here but what is quite ſimple, yet have maſters of muſic miſerably embroiled the whole matter.

Some diſſonances may be found which are never prepared: ſuch is the ſixth ſuperadded: ſome which are very unfrequently prepared; ſuch is the diminiſhed ſeventh.

PREPARATIONS, in pharmacy, the medicines when mixed together in ſuch a manner as to be fit for the uſe of the patient. See PHARMACY, Part II.

PREPARATIONS, in anatomy, the parts of animal bodies prepared and preſerved for anatomical uſes.

The manner of preſerving anatomical preparations, is either by drying them thoroughly in the air, or putting them into a proper liquor.

Edin. Med. Eſſays, vol ii. p. 8.

In drying parts which are thick, when the weather is warm, care muſt be taken to prevent putrefaction, fly-blows, inſects, &c. This is eaſily done by the uſe of a ſolution of corroſive ſublimate in ſpirit of wine, in the proportion of two drams of ſublimate to a pound of ſpirit: the part ſhould be moiſtened with this liquor as it dries, and by this method the body of a child may be kept ſafe even in ſummer. Dried preparations are apt to crack and moulder away in keeping; to prevent this, their ſurface ſhould be covered with a thick varniſh, repeated as often as occaſion requires.

Though ſeveral parts prepared dry are uſeful, yet others muſt be ſo managed as to be always flexible, and nearer a natural ſtate. The difficulty has been to find a proper liquor for this purpoſe. Dr Monro ſays, the beſt he knows is a well rectified colourleſs ſpirit of wine, to which is added a ſmall quantity of the ſpirit of vitriol or nitre. When theſe are properly mixed, they neither change their colour nor the conſiſtence of the parts, except where there are ſerous or mucous liquors contained in them. The brain, even of a young child, in this mixture grows ſo firm as to admit of gentle handling, as do alſo the vitreous and cryſtalline humours of the eye. The liquor of the ſebaceous glands and the ſemen are coagulated by this ſpirituous mixture; and it heightens the red colour of the injection of the blood-veſſels, ſo that after the part has been in it a little time, ſeveral veſſels appear which were before inviſible. If you will compare theſe effects with what Ruyſch has ſaid of his balſam, you will find the liquor abovementioned to come very near to it.

The proportion of the two ſpirits muſt be changed according to the part prepared. For the brain and humours of the eye, you muſt put two drams of ſpirit of nitre to one pound of ſpirit of wine. In preſerving other parts which are harder, 30 or 40 drops of the acid will be ſufficient; a larger quantity will make bones flexible, and even diſſolve them. The part thus preſerved ſhould be always kept covered with the liquor: therefore great care ſhould be taken to ſtop the mouth of the glaſs with a waxed cork and a bladder tied over it, to prevent the evaporation of the ſpirit; ſome of which, notwithſtanding all this care, will fly off; therefore freſh muſt be added as there is occaſion. When the ſpirits change to a dark tincture, which will ſometimes happen, they ſhould be poured off, and freſh put in their room; but with ſomewhat leſs acid than at firſt.

The glaſſes which contain the preparations ſhould be of the fineſt ſort, and pretty thick; for through ſuch the parts may be ſeen very diſtinctly, and of a true colour, and the object will be ſo magnified as to ſhow veſſels in the glaſs which out of it were not to be ſeen.

As the glaſs when filled with the liquor has a certain focus, it is neceſſary to keep the preparation at a proper diſtance from the ſides of it, which is eaſily done by little ſticks ſuitably placed, or by ſuſpending it by a thread in a proper ſituation. The operator ſhould be cautious of putting his fingers in this liquor oftener than is abſolutely neceſſary; becauſe it brings on a numbneſs on the ſkin, which makes the fingers unfit for any nice operation. The beſt remedy for this is to waſh them in water mixed with a few drops of oil of tartar per deliquium.

Dr Chriſt. Jac. Trew prefers the rectified ſpirit of grain for preſerving anatomical preparations to ſpirit of wine, or to compoſitions of alcohol, amber, camphor, &c. becauſe theſe ſoon change into a brown colour, whereas the ſpirit from malt preſerves its limpid appearance. When any part is to be preſerved wet, waſh it with water till it is no more tinctured. The water is next to be waſhed away with ſpirits, and then the preparation is to be put among ſpirits in a glaſs, the mouth of which is to be cloſely covered with a glaſs head, over which a wet bladder and leaf-tin are to be tied. *Com. Lit. Norimb.* 1731, *ſemeſt.* 1. *ſpecim.* 9. See alſo *Pole's Anatomical Inſtructor*, and *American Tranſactions*, vol. ii. p. 366.

PREPENSED, in law, denotes fore-thought. In which ſenſe we ſay *prepenſed malice*, &c. If, when a man is ſlain upon a ſudden quarrel, there were malice prepenſed formerly between them, it makes it murder; and, as it is called in ſome ſtatutes, *prepenſed murther*.

PREPOSITION, in grammar, one of the parts of ſpeech, being an indeclinable particle which yet ſerves to govern the nouns that follow it; ſuch as *per*, *pro*, *propter;* and through, for, with, &c.

F. Buffier allows it to be only a modificative of a part of ſpeech, ſerving to circumſtantiate a noun.

PREPUCE, in anatomy, the foreſkin; being a prolongation of the cutis of the penis, covering the glans. See ANATOMY, n° 107.

PREROGATIVE, in Engliſh law, an excluſive or uliar privilege.

Royal PREROGATIVE, that ſpecial pre-eminence which the king hath over and above all other perſons, and out of the ordinary courſe of the common law, in right of his regal dignity. It ſignifies in its etymology (from *præ* and *rogo*) ſomething that is required or demanded before, or in preference to, all others. And hence it follows, that it muſt be in its nature ſingular and eccentrical; that it can only be applied to thoſe rights and capacities which the king enjoys alone in contradiſtinction to others, and not to thoſe which he enjoys in common with any of his ſubjects: for if once any one prerogative of the crown could be held in common with the ſubject, it would ceaſe to be prerogative any longer. And therefore Finch lays it down as a maxim, that the prerogative is that law in caſe of the king, which is law in no caſe of the ſubject.

Prerogatives are either *direct* or *incidental*. The *direct* are ſuch poſitive ſubſtantial parts of the royal character and authority, as are rooted in, and ſpring from, the king's political perſon, conſidered merely by itſelf, without reference to any other extrinſic circumſtance; as, the right of ſending ambaſſadors, of creating peers, and of making war or peace. But ſuch prerogatives as are *incidental* bear always a relation to ſomething elſe, diſtinct from the king's perſon; and are indeed only exceptions, in favour of the crown, to thoſe general rules that are eſtabliſhed for the reſt of the community: ſuch as, that no coſts ſhall be recovered againſt the king; that the king can never be a joint tenant; and that his debt ſhall be preferred before a debt to any of his ſubjects.

Theſe ſubſtantive or direct prerogatives may again be divided into three kinds: being ſuch as regard, firſt, the king's royal *character* or *dignity;* ſecondly, his royal *authority* or *power;* and, laſtly, his royal *income*. Theſe are neceſſary, to ſecure reverence to his perſon, obedience to his commands, and an affluent ſupply for the ordinary expences of government; without all of which it is impoſſible to maintain the executive power in due independence and vigour. Yet, in every branch of that large and extenſive dominion, the conſtitution has interpoſed ſuch ſeaſonable checks and reſtrictions, as may crub it from trampling on thoſe liberties which it was meant to ſecure and eſtabliſh. The enormous weight of prerogative, if left to itſelf, (as in arbitrary governments it is), ſpreads havock and deſtruction among all the inferior movements: but, when balanced and bridled by its proper counterpoiſe, timely and judiciouſly applied, its operations are then equable and regular; it invigorates the whole machine, and enables every part to anſwer the end of its conſtruction.

I. Of the royal *dignity*. Under every monarchical eſtabliſhment, it is neceſſary to diſtinguiſh the prince from his ſubjects, not only by the outward pomp and decorations of majeſty, but alſo by aſcribing to him certain qualities as inherent in his royal capacity, diſtinct from, and ſuperior to, thoſe of any other individual in the nation. For though a philoſophical mind will (ſays Sir William Blackſtone) conſider the royal perſon merely as one man appointed by mutual conſent to preſide over many others, and will pay him that reverence and duty which the principles of ſociety demand; yet the maſs of mankind will be apt to grow inſolent and refractory, if taught to conſider their prince as a man of no greater perfection than themſelves. The law therefore aſcribes to the king, in his high political character, not only large powers and emoluments, which form his prerogative and revenue, but likewiſe certain attributes of a great and tranſcendent nature; by which the people are led to conſider him in the light of a ſuperior being, and to pay him that awful reſpect which may enable him with greater eaſe to carry on the buſineſs of government. This is what we underſtand by the royal dignity; the ſeveral branches of which we ſhall now proceed to enumerate.

1. And, firſt, the law aſcribes to the king the attribute of *ſovereignty*, or pre-eminency. See SOVEREIGNTY.

2. "The law alſo (according to Sir William Blackſtone) aſcribes to the king, in his political capacity, abſolute *perfection*. 'The king can do no wrong.' Which ancient and fundamental maxim (ſays he) is not to be underſtood as if every thing tranſacted by the government was of courſe juſt and lawful; but means only two things. Firſt, that whatever

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is exceptionable in the conduct of public affairs, is not to be imputed to the king, nor is he anſwerable for it perſonally to his people: for this doctrine would totally deſtroy that conſtitutional independence of the crown, which is neceſſary for the balance of power, in our free and active, and therefore compounded, conſtitution. And, ſecondly it means that the prerogative of the crown extends not to do any injury; it is created for the benefit of the people, and therefore cannot be exerted to their prejudice.—"The king, moreover, (he obſerves), is not only incapable of *doing* wrong, but even of *thinking* wrong: he can never mean to do an improper thing: in him is no folly or weakneſs. And, thererefore, if the crown ſhould be induced to grant any franchiſe or privilege to a ſubject contrary to reaſon, or in anywiſe prejudicial to the commonwealth or a private perſon, the law will not ſuppoſe the king to have meant either an unwiſe or an injurious action, but declares that the king was deceived in his grant; and thereupon ſuch grant is rendered void, merely upon the foundation of fraud and deception, either by or upon thoſe agents whom the crown has thought proper to employ. For the law will not caſt an imputation on that magiſtrate whom it entruſts with the executive power, as if he was capable of intentionally diſregarding his truſt: but attributes to mere impoſition (to which the moſt perfect of ſublunary beings muſt ſtill continue liable) thoſe little inadvertencies, which, if charged on the will of the prince, might leſſen him in the eyes of his ſubjects."

But this doctrine has been expoſed as ridiculous and abſurd, by Lord Abingdon, in his *Dedication to the collective Body of the People of England*. "Let us ſee (ſays he) how theſe maxims and their comments agree with the conſtitution, with nature, with reaſon, with common ſenſe, with experience, with fact, with precedent, and with Sir Willam Blackſtone himſelf; and whether, by the application of theſe rules of evidence thereto, it will not be found, that (from the want of attention to that important line of diſtinction which the conſtitution has drawn between the *king* of England and the *crown* of England) what was attributed to the *monarchy* has not been given to the *monarch*, what meant for the *kingſhip* conveyed to the *king*, what deſigned for the *thing* transferred to the *perſon*, what intended for *theory* applied to *practice*; and ſo in conſequence, that whilſt the premiſſes (of the perfection of the monarchy) be true, the concluſion (that the king can do no wrong) be not falſe.

"And, firſt, in reference to the conſtitution: to which if this matter be applied (meaning what it expreſſes, and if it do not it is unworthy of notice), it is ſubverſive of a principle in the conſtitution, upon which the preſervation of the conſtitution depends; I mean the principle of *reſiſtance*; a principle which, whilſt no man will now venture to gainſay, Sir William Blackſtone himſelf admits, '*is juſtifiable to the perſon of the prince*, when the being of the ſtate is endangered, and the public voice proclaims ſuch reſiſtance neceſſary;' and thus, by ſuch admiſſion, both diſproves the maxim, and overſets his own comment thereupon: for to ſay that 'the king can do no wrong,' and that 'he is incapable even of thinking wrong,' and then to admit that 'reſiſtance to his perſon is juſtifiable,' are ſuch jarring contradictions in themſelves, that, until reconciled, the neceſſity of argument is ſuſpended.

"With reſpect then, in the next place, to the agreement of this maxim, and its comment, with nature, with reaſon, and with common ſenſe, I ſhould have thought myſelf ſufficiently juſtified in appealing to every man's own reflection for deciſion, if I had not been made to underſtand that nature, reaſon, and common ſenſe, had had nothing to do with either. Sir William Blackſtone ſays, 'That though a philoſophical mind will conſider the royal perſon merely as one man appointed by mutual conſent to preſide over others, and will pay him that reverence and duty which the principles of ſociety demand, yet the maſs of mankind will be apt to grow inſolent and refractory if taught to conſider their prince as a man of no greater perfection than themſelves; and therefore the law aſcribes to the king, in his high political character, certain attributes of a great and tranſcendent nature, by which the people are led to conſider him in the light of a ſuperior being, and to pay him that awful reſpect which may enable him with greater eaſe to carry on the buſineſs of government. So that, in order to govern with greater eaſe (which by the bye is mere aſſertion without any proof), it is neceſſary to deceive the maſs of mankind, by making them believe, not only what a philoſophical mind cannot believe; but what it is impoſſible for any mind to believe; and therefore, in the inveſtigation of this ſubject, according to Sir William, neither nature, reaſon, nor common ſenſe, can have any concern.——

"It remains to examine in how much this maxim and its comment agree with experience, with fact, with precedent, and with Sir William Blackſtone himſelf. And here it is matter of moſt curious ſpeculation, to obſerve a maxim laid down, and which is intended for a rule of government, not only without a ſingle caſe in ſupport of it, but with a ſtring of caſes, that may be carried back to Egbert the firſt monarch of England, in direct oppoſition to the doctrine. Who is the man, that, reading the paſt hiſtory of this country, will ſhow us any king that has done no wrong? Who is the reader that will not find, that all the wrong and injuries which the free conſtitution of this country has hitherto ſuffered, have been ſolely derived from the arbitrary meaſures of our kings? And yet the maſs of mankind are to look upon the king as a ſuperior being; and the maxim, that 'the king can do no wrong,' is to remain as an article of belief. But, without puſhing this inquiry any farther, let us ſee what encouragement Sir William Blackſtone himſelf has given us for our credulity. After ſtating the maxim, and preſenting us with a moſt lively picture, 'of our ſovereign lord thus *all perfect* and *immortal*,' what does he make this all-perfection and immortality in the end to come to? His words are theſe: 'For when king Charles's deluded brother attempted to *enſlave* the nation,' (*no wrong this, to be ſure*), 'he found it was beyond his power: the people both *could*, and *did*, reſiſt him; and in conſequence of ſuch reſiſtence, obliged him to quit his enterpriſe and his throne together *.'"

The ſum of all is this: That the crown of England and the king of England are diſtinguiſhable, and not ſynonymous terms: that allegiance is due *to the crown*, and through the crown *to the king*: that the attributes of the crown are ſovereignty, perfection, and perpetuity; but that it does not therefore follow that the king can do no wrong. It is indeed to be admitted, that in high reſpect for the crown, high reſpect is alſo due to the wearer of that crown; that is, to the king: but the crown is to be preferred to the king, for the firſt veneration is due to the conſtitution. It is likewiſe *to be ſuppoſed* that the king *will* do no wrong: and as, to prevent this, a privy council is appointed by the conſtitution to aſſiſt the king in the execution of the government; ſo if any wrong be done, ‘ theſe men,’ as Monteſquieu expreſſes it, ‘ may be examined and puniſhed (A).’

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* Comment vol. iv. p. 433

“ But if any future king ſhall think to ſcreen theſe evil counſellors from the juſt vengeance of the people, by becoming *his own miniſter;* and, in ſo doing ſhall take for his ſanction *the attribute of perfection,* ſhall truſt to the deception of his being *a ſuperior being,* and cloak himſelf under the maxim that *the king can do no wrong;* I ſay, in ſuch a caſe, let the appeal already made to the conſtitution, to nature, to reaſon, to common ſenſe, to experience, to fact, to precedent, and to Sir William Blackſtone himſelf, ſuffice; and preclude the neceſſity of any further remarks from me (B).”

Blackſt. Comment.

To proceed now to other particulars: The law determines, that in the king can be no negligence, or LACHES; and therefore no delay will bar his right. *Nullum tempus occurrit regi,* is the ſtanding maxim upon all occaſions; for the law intends that the king is always buſied for the public good, and therefore has not leiſure to aſſert his right within the times limited to ſubjects. In the king alſo can be no ſtain or corruption of blood: for if the heir to the crown were attainted of treaſon or felony, and afterwards the crown ſhould deſcend to him, this would purge the attainder *ipſo facto.* And therefore, when Henry VII. who as earl of Richmond ſtood attainted, came to the crown, it was not thought neceſſary to paſs an act of parliament to reverſe this attainder; becauſe, as Lord Bacon in his hiſtory of that prince informs us, it was agreed that the aſſumption of the crown had at once purged all attainders. Neither can the king, in judgment of law, as king, ever be a minor or under age; and therefore his royal grants and aſſents to acts of parliament are good, though he has not in his natural capacity attained the legal age of 21. By a ſtatute, indeed, 28 Hen. VIII. c. 17. power was given to future kings to reſcind and revoke all acts of parliament that ſhould be made while they were under the age of 24: but this was repealed by the ſtatute 1 Edward VI. c. 11. ſo far as related to that prince, and both ſtatutes are declared to be determined by 24 Geo. II. c. 24. It hath alſo been uſually thought prudent, when the heir-apparent has been very young, to appoint a protector, guardian, or regent, ſor a limited time: but the very neceſſity of ſuch extraordinary proviſion is ſufficient to demonſtrate the truth of that maxim of common law, that in the king is no minority; and therefore he hath no legal guardian. See REGENT.

3. A third attribute of the king's majeſty is his *perpetuity.* The law aſcribes to him, in his political capacity, an abſolute immortality. The king never dies. Henry, Edward, or George, may die; but the king ſurvives them all. For, immediately upon the deceaſe of the reigning prince in his natural capacity, his kingſhip or imperial dignity, by act of law, without any *interregnum* or interval, is veſted at once in his heir; who is *eo inſtanti,* king to all intents and purpoſes. And ſo tender is the law of ſuppoſing even a poſſibility of his death, that his natural diſſolution is generally called his *demiſe; dimiſſia regis vel coronæ:* an expreſſion which ſignifies merely a transfer of property; for, as is obſerved in Plowden, when we ſay the demiſe of the crown, we mean only, that, in conſequence of the diſunion of the king's body-natural from his body-politic, the kingdom is transferred or demiſed to his ſucceſſor, and ſo the royal dignity remains perpetual. Thus, too, when Edward the fourth, in the tenth year of his reign, was driven from his throne for a few months by the houſe of Lancaſter, this temporary transfer of his dignity was denominated his *demiſe;* and all proceſs was held to be diſcontinued, as upon a natural death of the king.

II. We are next to conſider thoſe branches of the royal prerogative which inveſt this our ſovereign lord with a number of *authorities* and *powers;* in the exertion whereof conſiſts the executive part of government. This is wiſely placed in a ſingle hand by the Britiſh conſtitution, for the ſake of unanimity, ſtrength, and diſpatch. Were it placed in many hands, it would be ſubject to many wills: many wills, if diſunited and drawing different ways, create weakneſs in a government; and to unite thoſe ſeveral wills, and reduce them to one, is a work of more

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(A) Except the parliament, which is the great council of the nation, the judges, and the peers, who, being the hereditary counſellors of the crown, have not only a right, but are bound *in foro conſcientiæ* to adviſe the king for the public good, the conſtitution knows of no other counſel than the privy council. Any other counſel, like Clifford, Arlington, Buckingham, Aſhley, Lauderdale, and, as the initial letters of theſe names expreſs, is a CABAL, and as ſuch ſhould be ſuppreſſed. Nat. Bacon, ſpeaking of the loſs of power in the grand council of lords, ſays “ The ſenſe of ſtate once contracted into a privy-council, is ſoon recontracted into a cabinet council, and laſt of all into a *favourite* or two; which many times brings damage to the public, and both *themſelves* and *kings* into extreme *precipices;* partly for want of maturity, but principally through the providence of God over-ruling irregular courſes to the hurt of ſuch as walk in them.” *Pol. Diſc.* part. 2. p. 201.

(B) For experience, fact, and precedent, ſee the reigns of king John, Henry III. Edward. II. Richard II. Charles I. and James II. See alſo *Mirror of Juſtices;* where it is ſaid, “ that this grand aſſembly (meaning the now parliament, or then Wittenna-gemotte) is to conſider the government of God's people, how they may be kept from ſin, live in quiet, and have right done them, according to the cuſtoms and laws; and more eſpecially *of wrong done by the king,* queen, or their children:” to which Nat. Bacon adds this note: “ At this time *the king might do wrong,* &c. and ſo ſay Bracton and Fleta of the *kings* in their time.” *Diſc.* part 1. p. 37. Lond. 1739.

more time and delay than the exigencies of ſtate will afford. The king of England is therefore not only the chief, but properly the ſole, magiſtrate of the nation; all others acting by commiſſion from, and in due ſubordination to, him: in like manner as, upon the great revolution in the Roman ſtate, all the powers of the ancient magiſtracy of the commonwealth were concentered in the new emperor; ſo that, as Gravina expreſſes it, *in ejus unius perſona veteris rei publicæ vis atque majeſtas per cumulatas magiſtratuum poteſtates exprimebatur*.

Blackſt. Comment.

In the exertion of lawful prerogative the king is held to be abſolute; that is, ſo far abſolute, that there is no legal authority that can either delay or reſiſt him. He may reject what bills, may make what treaties, may coin what money, may create what peers, may pardon what offences, he pleaſes: unleſs where the conſtitution hath expreſsly, or by evident conſequence, laid down ſome exception or boundary; declaring, that thus far the prerogative ſhall go and no farther. For otherwiſe the power of the crown would indeed be but a name and a ſhadow, inſufficient for the ends of government, if, where its juriſdiction is clearly eſtabliſhed and allowed, any man or body of men were permitted to diſobey it, in the ordinary courſe of law: we do not now ſpeak of thoſe *extraordinary* recourſes to the firſt principles, which are neceſſary when the contracts of ſociety are in danger of diſſolution, and the law proves too weak a defence againſt the violence of fraud or oppreſſion. And yet the want of attending to this obvious diſtinction has occaſioned theſe doctrines, of abſolute power in the prince and of national reſiſtance by the people, to be much miſunderſtood and perverted, by the advocates for ſlavery on the one hand, and the demagogues of faction on the other. The former, obſerving the abſolute ſovereignty and tranſcendent dominion of the crown laid down (as it certainly is) moſt ſtrongly and emphatically in our law-books as well as our homilies, have denied that any caſe can be excepted from ſo general and poſitive a rule; forgetting how impoſſible it is, in any practical ſyſtem of laws, to point out beforehand thoſe eccentrical remedies, which the ſudden emergence of national diſtreſs may dictate, and which that alone can juſtify. On the other hand, over-zealous republicans, feeling the abſurdity of unlimited paſſive obedience, have fancifully (or ſometimes factiouſly) gone over to the other extreme: and, becauſe reſiſtance is juſtifiable to the perſon of the prince when the being of the ſtate is endangered, and the public voice proclaims ſuch reſiſtance neceſſary, they have therefore allowed to every individual the right of determining this expedience, and of employing private force to reſiſt even private oppreſſion. A doctrine productive of anarchy, and (in conſequence) equally fatal to civil liberty as tyranny itſelf. For civil liberty, rightly underſtood, conſiſts in protecting the rights of individuals by the united force of ſociety: ſociety cannot be maintained, and of courſe can exert no protection, without obedience to ſome ſovereign power; and obedience is an empty name, if every individual has a right to decide how far he himſelf ſhall obey.

In the exertion, therefore, of thoſe prerogatives which the law has given him, the king is irreſiſtible and abſolute, according to the forms of the conſtitution. And yet, if the conſequence of that exertion be manifeſtly to the grievance or diſhonour of the kingdom, the parliament will call his adviſers to a juſt and ſevere account. For prerogative conſiſting (as Mr Locke has well defined it) in the diſcretionary power of acting for the public good where the poſitive laws are ſilent, if that diſcretionary power be abuſed to the public detriment, ſuch prerogative is exerted in an unconſtitutional manner. Thus the king may make a treaty with a foreign ſtate, which ſhall irrevocably bind the nation; and yet, when ſuch treaties have been judged pernicious, impeachments have purſued thoſe miniſters by whoſe agency or advice they were concluded.

The prerogatives of the crown (in the ſenſe under which we are now conſidering them) reſpect either the nation's intercourſe with foreign nations, or its own domeſtic government and civil polity.

With regard to *foreign concerns*, the king is the delegate or repreſentative of his people. It is impoſſible that the individuals of a ſtate, in their collective capacity, can tranſact the affairs of that ſtate with another community equally numerous as themſelves. Unanimity muſt be wanting to their meaſures, and ſtrength to the execution of their counſels. In the king therefore, as in a centre, all the rays of his people are united, and form by that union a conſiſtency, ſplendor, and power, that make him feared and reſpected by foreign potentates; who would ſcruple to enter into any engagement, that muſt afterwards be reviſed and ratified by a popular aſſembly. What is done by the royal authority, with regard to foreign powers, is the act of the whole nation: what is done without the king's concurrence, is the act only of private men. And ſo far is this point carried by our law, that it hath been held, that ſhould all the ſubjects of England make war with a king in league with the king of England, without the royal aſſent, ſuch war is no breach of the league. And, by the ſtatute 2 Hen. V. c. 6. any ſubject committing acts of hoſtility upon any nation in league with the king, was declared to be guilty of high treaſon: and, though that act was repealed by the ſtatute 20 Hen. VI. c. 11. ſo far as relates to the making this offence high treaſon, yet ſtill it remains a very great offence againſt the law of nations, and puniſhable by our laws, either capitally or otherwiſe, according to the circumſtances of the caſe.

1. The king therefore, conſidered as the repreſentative of his people, has the ſole power of ſending ambaſſadors to foreign ſtates, and receiving ambaſſadors at home.

2. It is alſo the king's prerogative to make treaties, leagues, and alliances, with foreign ſtates and princes. For it is, by the law of nations, eſſential to the goodneſs of a league, that it be made by the ſovereign power; and then it is binding upon the whole community: and in Britain the ſovereign power, *quoad hoc*, is veſted in the perſon of the king. Whatever contracts therefore he engages in, no other power in the kingdom can legally delay, reſiſt, or annul. And yet, leſt this plenitude of authority ſhould be abuſed to the detriment of the public, the conſtitution (as was hinted before) hath here interpoſed a check, by the means of parliamentary impeachment, for the puniſhment of ſuch miniſters as from criminal motives adviſe or conclude any treaty, which ſhall afterwards be judged to derogate from the honour and intereſt of the nation.

3. Upon the ſame principle the king has alſo the ſole prerogative of making war and peace. For it is

held by all the writers on the law of nature and nations, that the right of making war, which by nature ſubſiſted in every individual, is given up by all private perſons that enter into ſociety, and is veſted in the ſovereign power: and this right is given up, not only by individuals, but even by the entire body of people that are under the dominion of a ſovereign. It would indeed be extremely improper, that any number of ſubjects ſhould have the power of binding the ſupreme magiſtrate, and putting him againſt his will in a ſtate of war. Whatever hoſtilities, therefore, may be committed by private citizens, the ſtate ought not to be affected thereby; unleſs that ſhould juſtify their proceedings, and thereby become partner in their guilt. And the reaſon which is given by Grotius, why, according to the law of nations, a denunciation of war ought always to precede the actual commencement of hoſtilities, is not ſo much that the enemy may be put upon his guard (which is matter rather of magnanimity than right), but that it may be certainly clear that the war is not undertaken by private perſons, but by the will of the whole community; whoſe right of willing is in this caſe transferred to the ſupreme magiſtrate by the fundamental laws of ſociety. So that, in order to make a war completely effectual, it is neceſſary in Britain that it be publicly declared and duly proclaimed by the king's authority; and then, all parts of both the contending nations, from the higheſt to the loweſt, are bound by it. And wherever the right reſides of beginning a national war, there alſo muſt reſide the right of ending it, or the power of making peace. And the ſame check of parliamentary impeachment, for improper or inglorious conduct, in beginning, conducting, or concluding a national war, is in general ſufficient to reſtrain the miniſters of the crown from a wanton or injurious exertion of this great prerogative.

4. But, as the delay of making war may ſometimes be detrimental to individuals who have ſuffered by depredations from foreign potentates, our laws have in ſome reſpects armed the ſubject with powers to impel the prerogative; by directing the miniſters of the crown to iſſue letters of marque and repriſal upon due demand: the prerogative of granting which is nearly related to, and plainly derived from, that other of making war; this being indeed only an incomplete ſtate of hoſtilities, and generally ending in a formal denunciation of war. Theſe letters are grantable, by the law of nations, whenever the ſubjects of one ſtate are oppreſſed and injured by thoſe of another, and juſtice is denied by that ſtate to which the oppreſſor belongs. In this caſe, letters of marque and repriſal (words in themſelves ſynonymous, and ſignifying a taking in return) may be obtained, in order to ſeize the bodies or goods of the ſubjects of the offending ſtate, until ſatisfaction be made, wherever they happen to be found. And indeed this cuſtom of repriſals ſeems dictated by nature herſelf; for which reaſon we find in the moſt ancient times very notable inſtances of it. But here the neceſſity is obvious of calling in the ſovereign power, to determine when repriſals may be made; elſe every private ſufferer would be a judge in his own cauſe. In purſuance of which principle, it is declared by the ſtatute 4 Hen. V. c. 7. that if any ſubjects of the realm are oppreſſed in time of truce by any foreigners, the king will grant marque in due form to all that feel themſelves grieved. See MARQUE.

5. Upon exactly the ſame reaſon ſtands the prerogative of granting ſafe-conducts; without which, by the law of nations, no member of one ſociety has a right to intrude into another. And therefore Puffendorff very juſtly reſolves, that it is left in the power of all ſtates to take ſuch meaſures about the admiſſion of ſtrangers as they think convenient; thoſe being ever excepted who are driven on the coaſts by neceſſity, or by any cauſe that deſerves pity or compaſſion. Great tenderneſs is ſhown by the laws, not only to foreigners in diſtreſs (ſee WRECK), but with regard alſo to the admiſſion of ſtrangers who come ſpontaneouſly: for ſo long as their nation continues at peace with ours, and they themſelves behave peaceably, they are under the king's protection; though liable to be ſent home whenever the king ſees occaſion. But no ſubject of a nation at war with us can, by the law of nations, come into the realm, nor can travel himſelf upon the high ſeas, or ſend his goods and merchandize from one place to another, without danger of being ſeized by our ſubjects, unleſs he has letters of ſafe-conduct; which, by divers ancient ſtatutes, muſt be granted under the king's great ſeal and inrolled in chancery, or elſe they are of no effect; the king being ſuppoſed the beſt judge of ſuch emergencies, as may deſerve exception from the general law of arms. But paſſports under the king's ſign-manual, or licences from his ambaſſadors abroad, are now more uſually obtained, and are allowed to be of equal validity.

Theſe are the principal prerogatives of the king reſpecting this nation's intercourſe with foreign nations; in all of which he is conſidered as the delegate or repreſentative of his people. But in domeſtic affairs, he is conſidered in a great variety of characters, and from thence there ariſes an abundant number of other prerogatives.

1. He is a conſtituent part of the ſupreme legiſlative power; and, as ſuch, has the prerogative of rejecting ſuch proviſions in parliament as he judges improper to be paſſed. The expediency of which conſtitution has before been evinced at large under the article PARLIAMENT. We ſhall only farther remark, that the king is not bound by any act of parliament, unleſs he be named therein by ſpecial and particular words. The moſt general words that can be deviſed (any perſon or perſons, bodies politic, or corporate, &c.) affect not him in the leaſt, if they may tend to reſtrain or diminiſh any of his rights or intereſts. For it would be of moſt miſchievous conſequence to the public, if the ſtrength of the executive power were liable to be curtailed, without its own expreſs conſent, by conſtructions and implications of the ſubject. Yet, where an act of parliament is expreſsly made for the preſervation of public rights and the ſuppreſſion of public wrongs, and does not interfere with the eſtabliſhed rights of the crown, it is ſaid to be binding as well upon the king as upon the ſubject: and, likewiſe, the king may take the benefit of any particular act, though he be not eſpecially named.

2. The king is conſidered, in the next place, as the generaliſſimo, or the firſt in military command, within the kingdom. The great end of ſociety is to protect the weakneſs of individuals by the united ſtrength of

the community; and the principal uſe of government is to direct that united ſtrength in the beſt and moſt effectual manner, to anſwer the end propoſed. Monarchical government is ſuppoſed to be the fitteſt of any for this purpoſe: it follows therefore, from the very end of its inſtitution, that in a monarchy the military power muſt be truſted in the hands of the prince.

In this capacity, therefore, of general of the kingdom, the king has the ſole power of raiſing and regulating fleets and armies. The manner in which they are raiſed and regulated is explained under the article *Military State*. We are now only to conſider the prerogative of enliſting and of governing them: which indeed was diſputed and claimed, contrary to all reaſon and precedent, by the long parliament of king Cha. I.; but, upon the reſtoration of his ſon, was ſolemnly declared by the ſtatute 13 Charles II. c. 6. to be in the king alone: for that the ſole ſupreme government and command of the militia within all his majeſty's realms and dominions, and of all forces by ſea and land, and of all forts and places of ſtrength, ever was and is the undoubted right of his majeſty, and his royal predeceſſors, kings and queens of England; and that both or either houſe of parliament cannot, nor ought to, pretend to the ſame.

This ſtatute, it is obvious to obſerve, extends not only to fleets and armies, but alſo to forts and other places of ſtrength within the realm; the ſole prerogative, as well of erecting, as manning and governing of which, belongs to the king in his capacity of general of the kingdom: and all lands were formerly ſubject to a tax, for building of caſtles wherever the king thought proper. This was one of the three things, from contributing to the performance of which no lands were exempted, and therefore called by the Anglo-Saxons the *trinoda neceſſitas; ſc. pontis reparatio, arcis conſtructio, et expeditio contra hoſtem.* And this they were called upon to do ſo often, that, as Sir Edward Coke from M. Paris aſſures us, there were in the time of Henry II. 1115 caſtles ſubſiſting in England. The inconveniencies of which, when granted out to private ſubjects, the lordly barons of thoſe times, were ſeverely felt by the whole kingdom; for, as William of Newburg remarks in the reign of king Stephen, *erant in Anglia quodammodo tot reges vel potius tyranni, quot domini caſtellorum*; but it was felt by none more ſenſibly than by two ſucceeding princes, king John and king Henry III. And therefore, the greateſt part of them being demoliſhed in the baron's wars, the kings of after times have been very cautious of ſuffering them to be rebuilt in a fortified manner: and Sir Edward Coke lays it down, that no ſubject can build a caſtle, or houſe of ſtrength imbattled, or other fortreſs defenſible, without the licence of the king; for the danger which might enſue, if every man at his pleaſure might do it.

It is partly upon the ſame, and partly upon a fiſcal foundation, to ſecure his marine revenue, that the king has the prerogative of appointing *ports* and *havens*, or ſuch places only, for perſons and merchandize to paſs into and out of the realm, as he in his wiſdom ſees proper. By the feodal law, all navigable rivers and havens were computed among the regalia, and were ſubject to the ſovereign of the ſtate. And in England it hath always been held, that the king is lord of the whole ſhore, and particularly is the guardian of the ports and havens, which are the inlets and gates of the realm: and therefore, ſo early as the reign of king John, we find ſhips ſeized by the king's officers for putting in at a place that was not a legal port. Theſe legal ports were undoubtedly at firſt aſſigned by the crown; ſince to each of them a court of portmote is incident, the juriſdiction of which muſt flow from the royal authority: the *great ports* of the ſea are alſo referred to as well known and eſtabliſhed, by ſtatute 4 Hen. IV. c. 20. which prohibits the landing elſewhere under pain of confiſcation; and the ſtatute 1 Eliz. c. 11. recites, that the franchiſe of lading and diſcharging had been frequently granted by the crown.

But though the king had a power of granting the franchiſe of havens and ports, yet he had not the power of reſumption, or of narrowing and confining their limits when once eſtabliſhed; but any perſon had a right to load or diſcharge his merchandiſe in any part of the haven: whereby the revenue of the cuſtom was much impaired and diminiſhed, by fraudulent landings in obſcure and private corners. This occaſioned the ſtatutes of Eliz. c. 11. and 13 and 14 Car. II. c. 11. § 14. which enable the crown by commiſſion, to aſcertain the limits of all ports, and to aſſign proper wharfs and quays in each port, for the excluſive landing and loading of merchandiſe.

The erection of beacons, light-houſes, and ſea-marks, is alſo a branch of the royal prerogative: whereof the firſt was anciently uſed in order to alarm the country, in caſe of the approach of an enemy; and all of them are ſignally uſeful in guiding and preſerving veſſels at ſea by night as well as by day. See BEACON.

3. Another capacity in which the king is conſidered in domeſtic affairs, is as the fountain of juſtice and general conſervator of the peace of the kingdom. See the article *Fountain of* JUSTICE.

4. The king is likewiſe the fountain of honour, of office, and of privilege: and this in a different ſenſe from that wherein he is ſtyled the *fountain of juſtice*; for here he is really the parent of them. See the articles *Fountain of* JUSTICE and *Fountain of* HONOUR.

5. Another light, in which the laws of England conſider the king with regard to domeſtic concerns, is as the arbiter of commerce. By commerce, we at preſent mean domeſtic commerce only; for the king's prerogative with regard to which ſee *Regulation of* WEIGHTS *and Meaſures*, MONEY, &c.

6. The king is, laſtly, conſidered by the laws of England as the head and ſupreme governor of the national church.

To enter into the reaſons upon which this prerogative is founded is matter rather of divinity than of law. We ſhall therefore only obſerve, that by ſtatute 26 Hen. VIII. c. 1. (reciting that the king's majeſty juſtly and rightfully is and ought to be the ſupreme head of the church of England; and ſo had been recogniſed by the clergy of that kingdom in their convocation) it is enacted, that the king ſhall be reputed the only ſupreme head in earth of the church of England; and ſhall have, annexed to the imperial crown of this realm, as well the title and ſtyle thereof, as all juriſdictions, authorities, and commodities, to the ſaid dignity of ſupreme head of the church appertaining. And another ſtatute to the ſame purport was made, 1 Eliz. c. 1.

In virtue of this authority the king convenes, prorogues,

rogues, reſtrains, regulates, and diſſolves, all eccleſiaſtical ſynods or convocations. This was an inherent prerogative of the crown long before the time of Henry VIII. as appears by the ſtatute 8 Hen. VI. c. 1. and the many authors, both lawyers and hiſtorians, vouched by Sir Edward Coke. So that the ſtatute 25 Hen. VIII. c. 19. which reſtrains the convocation from making or putting in execution any canons repugnant to the king's prerogative, or the laws, cuſtoms, and ſtatutes of the realm, was merely declaratory of the old common law: that part of it only being new, which makes the king's royal aſſent actually neceſſary to the validity of every canon. The convocation or eccleſiaſtical ſynod, in England, differs conſiderably in its conſtitution from the ſynods of other Chriſtian kingdoms: thoſe conſiſting wholly of biſhops; whereas in England the convocation is the miniature of a parliament, wherein the archbiſhop preſides with regal ſtate; the upper houſe of biſhops repreſents the houſe of lords; and the lower houſe, compoſed of repreſentatives of the ſeveral dioceſes at large, and of each particular chapter therein, reſembles the houſe of commons with its knights of the ſhire and burgeſſes. This conſtitution is ſaid to be owing to the policy of Edward I. who thereby at one and the ſame time let in the inferior clergy to the privileges of forming eccleſiaſtical canons (which before they had not), and alſo introduced a method of taxing eccleſiaſtical benefices, by conſent of convocation.

From this prerogative alſo, of being the head of the church, ariſes the king's right of nomination to vacant biſhoprics, and certain other eccleſiaſtical preferments.

As head of the church, the king is likewiſe the *dernier reſort* in all eccleſiaſtical cauſes; an appeal lying ultimately to him in chancery from the ſentence of every eccleſiaſtical judge: which right was reſtored to the crown by ſtatute 25 Hen. VIII. c. 9.

III. The king's fiſcal prerogatives, or ſuch as regard his revenue. See the article REVENUE.

Prerogative-Court, an Engliſh court eſtabliſhed for the trial of all teſtamentary cauſes, where the deceaſed hath left *bona notabilia* within two different dioceſes. In which caſe the probate of wills belongs to the archbiſhop of the province, by way of ſpecial prerogative. And all cauſes relating to the wills, adminiſtrations, or legacies of ſuch perſons, are originally cognizable herein, before a judge appointed by the archbiſhop, called the *judge of the prerogative-court*; from whom an appeal lies by ſtatute 25 Hen. VIII. c. 19. to the king in chancery, inſtead of the pope as formerly.

PRESAGE, in antiquity, denotes an augury, or ſign of ſome future event; which was chiefly taken from the flight of birds, the entrails of victims, &c. See AUGURY and ARUSPICES.

PRESBURG, the capital of the kingdom of Lower Hungary, called by the inhabitants *Poſony* and *Preſporen*, ſituated on the Danube, about 46 miles eaſt from Vienna, and 75 from Buda. The caſtle, in which the regalia are kept, ſtands on a hill above the town. Here the ſtates aſſemble; and in the cathedral, dedicated to St Martin, the king is crowned. The town is not very large, nor well built; but is very ancient, pleaſantly ſituated, and enjoys a good air. Its fortifications are only a double wall and ditch. In the lower ſuburbs is a hill, where the king, after his coronation, goes on horſeback, and brandiſhes St. Stephen's ſword towards the four cardinal points, intimating, that he will defend his country againſt all its enemies. Beſides the cathedral, there are ſeveral other Popiſh and one Lutheran church, with a Jeſuits college, three convents, and two hoſpitals. It gives name to a country; and is the reſidence of the archbiſhop of Gran, who is primate, chief ſecretary, and chancellor of the kingdom, *legatus natus* of the Papal ſee, and prince of the holy Roman empire. E. Long. 17. 30. N. Lat. 48. 20.

PRESBYTÆ, perſons whoſe eyes are too flat to refract the rays ſufficiently, ſo that unleſs the object is at ſome diſtance, the rays coming from it will paſs through the retina before their union, conſequently viſion is confuſed; old people are uſually the ſubjects of this diſeaſe. In order to remedy, or at leaſt to palliate, this defect, the perſon ſhould firſt uſe glaſſes which do not magnify, and from them paſs gradually to more convex ſpectacles, which ſhorten the focus.

PRESBYTER, in the primitive Chriſtian church, an elder, one of the ſecond order of eccleſiaſtics; the other two being biſhops and deacons. See the articles BISHOP and DEACON.

Preſbyter or elder is a word borrowed from the Greek tranſlation of the Old Teſtament, where it commonly ſignifies ruler or governor; it being a note of office and dignity, not of age; and in this ſenſe biſhops are ſometimes called *preſbyters* in the New Taſtament. The preſbyters might baptize, preach, conſecrate, and adminiſter the euchariſt in the biſhop's abſence, or in his preſence if he authoriſed and deputed them; and the biſhops did ſcarce any thing in the government of the church without their advice, conſent, and amicable concurrence.

The grand diſpute between the followers of the Geneva and Roman diſcipline, is about the ſameneſs and difference of preſbyters and biſhops at the time of the apoſtles. See EPISCOPACY, INDEPENDENTS, and the following article.

1 Diſcriminating principle of the Preſbyterians.

PRESBYTERIANS, Proteſtants, ſo called from their maintaining that the government of the church appointed in the New Teſtament was by preſbyteries, that is, by aſſociations of miniſters and ruling elders, poſſeſſed all of equal powers, without any ſuperiority among them either in office or in order.

The Preſbyterians believe, that the authority of their miniſters to preach the goſpel, to adminiſter the ſacraments of baptiſm and the Lord's ſupper, and to feed the flock of Chriſt, is derived from the Holy Ghoſt by the impoſition of the hands of the preſbytery; and they oppoſe the independent ſcheme of the common rights of Chriſtians by the ſame arguments which are uſed for that purpoſe by the Epiſcopalians (ſee EPISCOPACY). They affirm, however, that there is no order in the church as eſtabliſhed by Chriſt and his apoſtles ſuperior to that of preſbyters; that all miniſters being ambaſſadors of Chriſt, are equal by their commiſſion; that *preſbyter* and *biſhop*, though different words, are of the ſame import; and that prelacy was gradually eſtabliſhed upon the primitive practice of making the *moderator* or ſpeaker of the preſbytery a permanent officer.

2 Scriptural arguments againſt epiſcopacy.

Theſe poſitions they maintain againſt the Epiſcopalians by the following ſcriptural arguments. They obſerve, that the apoſtles planted churches by ordaining biſhops and deacons in every city; that the miniſters which in one verſe are called biſhops are in the next perhaps denominated preſbyters; that we nowhere read in the New Teſtament of biſhops, preſbyters, and deacons, in any one church; and that therefore we are under the neceſſity of concluding *biſhop* and *preſbyter* to be two names for the ſame church officer. This is apparent from Peter's exhortation to the *elders* or *preſbyters* who were among the Jewiſh Chriſtians. "The *elders* (preſbyters) which are among you I exhort, who am alſo an *elder*, and a witneſs of the ſufferings of Chriſt, and alſo a partaker of the glory that ſhall be revealed: Feed the flock of God which is among you, taking the *overſight* thereof (επισκοπουντες acting as *biſhops* thereof), not by conſtraint, but willingly; not for filthy lucre, but of a ready mind; neither as being LORDS over God's heritage, but being enſamples to the flock *." From this paſſage it is evident, that the preſbyters not only fed the flock of God, but alſo governed that flock with epiſcopal powers; and that the apoſtle himſelf, as a church officer, was nothing more than a preſbyter or elder. The identity of the office of biſhop and preſbyter is ſtill more apparent from Heb. xiii. 7. 17. and 1 Theſſ. v. 12.; for the biſhops are there repreſented as governing the flock, ſpeaking to them the word of God, watching for their ſouls, and diſcharging various offices, which it is impoſſible for any man to perform to more than one congregation.

3
Reaſons for ſuppoſing biſhops and preſbyters of the ſame order.

From the laſt cited text it is evident, that the biſhops (προισταμενους) of the Theſſalonian churches had the paſtoral care of no more ſouls than they could hold perſonal communion with in God's worſhip; for they were ſuch as all the people were to *know*, *eſteem*, and *love*, as thoſe that not only were *over them*, but alſo "cloſely laboured among them and admoniſhed them." But dioceſan biſhops, whom ordinarily the hundredth part of their flock never hear nor ſee, cannot be thoſe biſhops by whom that flock is admoniſhed, nor can they be what Peter requires the biſhops of the Jewiſh converts to be, *enſamples to the flock*. It is the opinion of Dr Hammond, who was a very learned divine, and a zealot for epiſcopacy, that the *elders* whom the apoſtle James deſires † the ſick to call for, were of the higheſt permanent order of eccleſiaſtical officers; but it is ſelf-evident that thoſe elders cannot have been dioceſan biſhops, otherwiſe the ſick muſt have been often without the reach of the remedy propoſed to them.

There is nothing in Scripture upon which the Epiſcopalian is more ready to reſt his cauſe than the alleged epiſcopacy of Timothy and Titus; of whom the former is ſaid to have been biſhop of Epheſus, and the latter biſhop of Crete; yet the Preſbyterian thinks it as clear as the noon-day ſun, that the preſbyters of Epheſus were ſupreme governors under Chriſt of the Epheſian churches, at the very time that Timothy is pretended to have been their proper dioceſan.

In Acts xx. 17, &c. we read, that "from Miletus Paul ſent to Epheſus, and called the elders (preſbyters) of the church. And when they were come to him, he ſaid unto them, Ye know, from the firſt day that I came into Aſia, after what manner I have been with you, at all ſeaſons. And now I know that ye all, among whom I have gone preaching the kingdom of God, ſhall ſee my face no more. Wherefore I take you to record this day, that I am pure from the blood of all men. For I have not ſhunned to declare unto you all the counſel of God. Take heed therefore unto yourſelves, and to all the flock over which the Holy Ghoſt hath made you overſeers (επισκοπους *biſhops*), to feed the church of God, which he hath purchaſed with his own blood. For I know this, that after my departure ſhall grievous wolves enter in among you, not ſparing the flock. Alſo of your ownſelves ſhall men ariſe, ſpeaking perverſe things, to draw away diſciples after them. Therefore watch, and remember, that by the ſpace of three years, I ceaſed not to warn every one night and day with tears. And now, brethren, I recommend you to God, and to the word of his grace," &c.

4
The paſtors of Epheſus of equal authority.

From this paſſage, it is evident that there was in the city of Epheſus a plurality of paſtors of equal authority without any ſuperior paſtor or biſhop over them; for the apoſtle directs his diſcourſe to them all in common, and gives them equal power over the whole flock. Dr Hammond indeed imagines, that the elders whom Paul called to Miletus were the *biſhops* of *Aſia*, and that he ſent for them to Epheſus, becauſe that city was the metropolis of the province. But were this opinion well-founded, it is not conceivable that the ſacred writer would have called them the elders of the church of *Epheſus*, but the elders of the *church in general*, or the elders of the *churches in Aſia*. Beſides, it is to be remembered, that the apoſtle was in ſuch haſte to be at Jeruſalem, that the ſacred hiſtorian meaſures his time by *days*; whereas it muſt have required ſeveral months to call together the biſhops or elders of all the cities of Aſia; and he might certainly have gone to meet them at Epheſus in leſs time than would be requiſite for their meeting in that city and proceeding thence to him at Miletus. They muſt therefore have been either the joint paſtors of one congregation, or the paſtors of different congregations in one city: and as it was thus in Epheſus, ſo was it in Philippi; for we find the apoſtle addreſſing his epiſtle "to all the ſaints in Chriſt Jeſus which are at Philippi, with the biſhops and deacons." From the paſſage before us it is likewiſe plain, that the preſbyters of Epheſus had not only the *name* but the whole *power* of biſhops given to them by the Holy Ghoſt; for they are enjoined to do the whole work of biſhops—ποιμαινειν την εκκλησιαν του θεου—which ſignifies, to *rule* as well as *feed* the church of God. Whence we ſee, that the apoſtle makes the power of *governing* inſeparable from that of *preaching* and *watching*; and that according to him, all who are preachers of God's word, and watchmen of ſouls, are neceſſarily rulers or governors of the church, without being accountable for their management to any prelate, but only to their Lord Chriſt from whom their power is derived.

5
Timothy no biſhop.

It appears therefore, that the apoſtle Paul left in the church of Epheſus, which he had planted, no other ſucceſſors to himſelf than *preſbyter-biſhops*, or Preſbyterian miniſters, and that he did not devolve his power upon any prelate. Timothy, whom the Epiſcopalians allege to have been the firſt biſhop of Epheſus, was preſent when this ſettlement was made *; and it is ſurely not to be ſuppoſed, that, had he been their biſhop, the apoſtle would have devolved the whole epiſcopal power upon the preſbyters before his face. If ever there was a ſeaſon fitter than another for pointing out the duty of this ſuppoſed biſhop to his dioceſe, and his preſbyters duty to him, it was ſurely when Paul was taking his final leave of them, and diſcourſing ſo pathetically concerning the duty of *overſeers*, the coming of ravenous wolves, and the conſequent hazard of the flock. In this farewell diſcourſe, he tells them that "he had not ſhunned to declare unto them all the counſel of God." But with what truth could this have been ſaid, if obedience to a dioceſan biſhop had been any part of their duty either at the time of the apoſtle's ſpeaking or at any future period? He foreſaw that ravenous wolves would enter in among them, and that even ſome of themſelves ſhould ariſe ſpeaking perverſe things; and if, as the Epiſcopalians allege, dioceſan epiſcopacy was the remedy provided for thoſe evils, is it not ſtrange, paſſing ſtrange, that the inſpired preacher did not foreſee that Timothy, who was ſtanding beſide him, was deſtined to fill that important office; or if he did foreſee it, that he omitted to recommend him to his future charge, and to give him proper inſtructions for the diſcharge of his duty?

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* 1 Peter v. 1, 2, 3.

† Chap. v. 14.

* Acts xx. 5.

6
But an evangeliſt.

But if Timothy was not biſhop of Epheſus, what, it may be aſked, was his office in that city? for that he reſided there for ſome time, and was by the apoſtle inveſted with authority to ordain and rebuke preſbyters, are facts about which all parties are agreed, and which indeed cannot be controverted by any reader of Paul's epiſtles. To this the Preſbyterian replies with confidence, that the power which Timothy exerciſed in the church of Epheſus was that of an evangeliſt †, and not a fixed prelate. But, according to Euſebius, the work of an evangeliſt was, "to lay the foundations of the faith in barbarous nations, and to conſtitute among them paſtors; after which he paſſed on to other countries." Accordingly we find, that Timothy was reſident for a time at Philippi and Corinth ‡ as well as at Epheſus, and that he had as much authority over thoſe churches as over that of which he is ſaid to have been the fixed biſhop. "Now, if Timotheus come, ſee that he may be with you without fear, for he worketh the work of the Lord, as I alſo do. Let no man therefore deſpiſe him." This text might lead us to ſuppoſe, that Timothy was biſhop of Corinth as well as of Epheſus; for it is ſtronger than that upon which his epiſcopacy of the latter church is chiefly built. The apoſtle ſays, "I beſought thee * to abide ſtill at Epheſus, when I went into Macedonia, that thou mighteſt charge ſome that they teach no other doctrine." But had Timothy been the fixed biſhop of that city, there would ſurely have been no neceſſity for *beſeeching* him to abide with his flock. It is to be obſerved, too, that the firſt epiſtle to Timothy, which alone was written to him during his reſidence at Epheſus, was of a date prior to Paul's meeting with the elders of that church at Miletus; for in the epiſtle he hopes to come to him ſhortly, whereas he tells the elders at Miletus that they ſhould ſee his face no more. This being the caſe, it is evident that Timothy was left by the apoſtle at Epheſus only to ſupply his place during his temporary abſence at Macedonia, and that he could not poſſibly have been conſtituted fixed biſhop of that church, ſince the epiſcopal powers were afterwards committed to the preſbyters by the Holy Ghoſt in his preſence.

7
Preſbyterate the higheſt permanent office in the church.

The identity of the office of biſhop and preſbyter being thus clearly eſtabliſhed, it follows, that the preſbyterate is the higheſt permanent office in the church, and that every faithful paſtor of a flock is ſucceſſor to the apoſtles in every thing in which they were to have any ſucceſſors. In the apoſtolic office there were indeed ſome things peculiar and extraordinary, ſuch as their immediate call by Chriſt, their infallibility, their being witneſſes of our Lord's reſurrection, and their unlimited juriſdiction over the whole world. Theſe powers and privileges could not be conveyed by impoſition of hands to any ſucceſſors, whether called preſbyters or biſhops; but as rulers or office-bearers in particular churches, we have the confeſſion of "the very chiefeſt apoſtles," Peter and John, that they were nothing more than preſbyters or pariſh miniſters. This being the caſe, the diſpute, which in the early part of the paſſing century was ſo warmly agitated concerning the validity of Preſbyterian ordination, may be ſoon decided; for if the ceremony of ordination be at all eſſential, it is obvious that ſuch a ceremony performed by preſbyters muſt be valid, as there is no higher order of eccleſiaſtics in the church by whom it can be performed. Accordingly we find, that Timothy himſelf, though ſaid to be a biſhop, was ordained by the laying on of the hands of a preſbytery. At that ordination indeed St Paul preſided, but he could preſide only as *primus in paribus*; for we have ſeen that, as permanent officers in the church of Chriſt, the apoſtles themſelves were no more than preſbyters. If the apoſtles hands were impoſed for any other purpoſe, it muſt have been to communicate thoſe *chariſmata* or miraculous gifts of the Holy Spirit, which were then ſo frequent; but which no modern preſbyter or biſhop will pretend to give, unleſs his underſtanding be clouded by the groſſeſt ignorance, or perverted by the moſt frantic enthuſiaſm.

8
Riſe of epiſcopacy.

But if the office of biſhop and preſbyter was originally the ſame, how, it will be aſked, came dioceſan epiſcopacy to prevail ſo univerſally as it is confeſſed to have done before the converſion of Conſtantine and the civil eſtabliſhment of Chriſtianity in the Roman empire? To give a ſatisfactory anſwer to this queſtion is certainly the moſt arduous taſk which the advocate for preſbytery has to perform; but it is a taſk not inſurmountable.

From many paſſages in the New Teſtament *, it is evident, that when the apoſtles planted churches in different cities, they generally ſettled more than one paſtor in the ſame church, to feed and govern it with joint authority. The propriety of this conſtitution is obvious. In thoſe days, when the diſciples of Chriſt were perſecuted for their religion, and often obliged to meet in the "night for fear of the Jews," they could not with any degree of prudence aſſemble in large numbers; and therefore, had there been no more than one paſtor in a city, the Chriſtian converts, though, when aſſembled, they might have amounted to but a ſmall congregation, could not all have enjoyed the benefit of public worſhip on the ſame day; at leaſt it is obvious that they could not poſſibly have aſſembled for this purpoſe ſo often as their want of inſtruction, and the duty of "breaking of bread and of prayer," required them to meet. It was therefore with great wiſdom that the apoſtles ordained ſeveral preſbyters in the ſame church; but as theſe preſbyters would have occaſion to meet frequently, and to deliberate on the ſtate of the flock which it was their duty to feed, and over which they had all equal authority, they would be under the neceſſity of electing one of their own number

† 2 Tim. 4. 5.

‡ Phil. ii. 19. 1 Cor. iv. 17. xvi. 10, 11.

* 1 Tim. i. 3.

* Acts xi. 29. xiii. 1, 2. 3. xv. Tit. i. 5.

Preſbyterians.

number to be preſident or *moderator* of the preſbytery, that order might be preſerved, and all things done with decency. At firſt there is reaſon to believe that thoſe preſidents held their office no longer than while the preſbyteries ſat in which they were elected. Among the apoſtles themſelves there was no fixed preſident. Peter indeed appears to have been moſt frequently admitted to that honour; but there is one very memorable occaſion on record †, when James the Lord's brother preſided in an aſſembly of apoſtles, elders, and brethren, held at Jeruſalem, to determine the queſtion concerning the neceſſity of circumciſing the Gentiles, and commanding them to keep the law of Moſes.

† Acts xv.

Upon this model were the primitive preſbyteries formed. They conſiſted of ſeveral preſbyters poſſeſſed of equal powers, who at their meetings appointed one of their own number to diſcharge the office of moderator or temporary preſident; but to this preſident they gave no prelatical powers or negative voice over the deliberations of his brethren; for, as Jerome informs us, the church was then governed *communi preſbyterorum concilio*, "by a common council of preſbyters." It appears, however, that when an apoſtle, an apoſtolical man, or an evangeliſt, fixed his reſidence in any city, and took upon himſelf the paſtoral care of part of the flock, his co-preſbyters, from reſpect to his ſingular gifts, made him their conſtant and fixed moderator. Hence Timothy, during his abode at Epheſus, was moderator of the preſbytery; and hence too Mark the evangeliſt, who reſided many years in Alexandria, has been called the firſt biſhop of that church, though he appears to have been nothing more than permanent moderator. We advance this upon the authority of Jerome, one of the moſt learned fathers of the Chriſtian church, who informs us, that upon the death of the evangeliſt, the preſbyters of Alexandria, for more than 200 years, choſe their biſhops from their own number, and placed them in the epiſcopal chair, without dreaming that they ought to be raiſed to a higher order by a new conſecration;—*Preſbyteri unum ex ſe electum in excelſiori gradu collocatum, epiſcopum nominabant.* As this practice of making the moderator of the preſbytery of Alexandria a permanent officer, was thought a good expedient to guard the infant churches againſt ſchiſms and diviſions, thoſe churches gradually adopted it. For, as Jerome tells us, *Poſtquam unuſquiſque eos quos baptizaverat, ſuos putabat eſſe, non Chriſti, in toto orbe decretum eſt, ut unus de preſbyteris electus, ſuperponeretur cæteris, ad quem omnis eccleſiæ cura pertineret, et ſchiſmatum ſemina tollerentur.*

9 According to Jerome.

The advantages which, in diſplaying his talents and authority, the perpetual preſident or ſpeaker of any aſſembly has over his colleagues in office, are ſo obvious, that when the practice of electing their moderators for life became univerſal among the preſbyteries of the primitive church, it is eaſy to conceive how ambitious men might ſo magnify the difficulties and importance of their ſtation, as to introduce the cuſtom of filling it by a new conſecration of the biſhop elect. But when this was done, dioceſan epiſcopacy, with all its powers and prerogatives, would follow as a thing of courſe, until "by little and little (as Jerome expreſſes himſelf) the whole paſtoral care of the flock was devolved upon one man."

Our limits will not permit us to trace more minutely the riſe and progreſs of this eccleſiaſtical uſurpation, as the Preſbyterian calls it; but the reader who wiſhes for fuller information, after ſtudying the remains of the four firſt centuries of the Chriſtian church, may conſult *An Inquiry into the Conſtitution, Diſcipline, and Worſhip, of the Primitive Church*, ſaid to have been written by Sir Peter King, afterwards lord chancellor of England. As an impartial lover of truth, he will do well to conſult alſo a book intitled *An original Draught of the Primitive Church*, which was publiſhed as an anſwer to the Inquiry; and he may read with much advantage to himſelf *A Letter from a parochial biſhop to a prelatical gentleman*, with *An Apology for the church of Scotland*, both written by Mr Williſon ſome time miniſter in Dundee, and both evincing conſiderable learning and great ingenuity in their pious author.

10 The church of Scotland

Of the churches at preſent formed upon this model, we believe, that without heſitation, we may ſafely affirm the church of Scotland to be in general the moſt reſpectable. Her mode of worſhip is ſimple and ſolemn; her eſtabliſhed faith agreeable to the confeſſions of moſt other Proteſtant churches; her judicatories are calculated to maintain the rights of the people; and her paſtors are confeſſedly men of liberal and enlightened minds. On theſe accounts it appears to us, that we cannot more properly conclude this article than with a ſhort view of her conſtitution, as being that in which our Preſbyterian readers will find themſelves moſt intereſted.

No one is ignorant, that from the firſt dawn of reformation in Scotland, till the era of the revolution, there was a perpetual ſtruggle between the court and the people for the eſtabliſhment of an Epiſcopal or a Preſbyterian form of church government: The former model of eccleſiaſtical polity was patroniſed by the houſe of Stuart on account of the ſupport which it gave to the prerogatives of the crown; the latter was the favourite of the majority of the people, perhaps not ſo much on account of its ſuperior claim to apoſtolical inſtitution, as becauſe the laity are mixed with the clergy in church judicatories, and the two orders, which under epiſcopacy are kept ſo diſtinct, incorporated, as it were, into one body. In the Scottiſh church, every regulation of public worſhip, every act of diſcipline, and every eccleſiaſtical cenſure, which in other churches flows from the authority of a dioceſan biſhop, or from a convocation of the clergy, is the joint work of a certain number of clergymen and laymen acting together with equal authority, and deciding every queſtion by a plurality of voices. The laymen who thus form an eſſential part of the eccleſiaſtical courts of Scotland, are called *ruling elders*; and hold the ſame office, as well as the ſame name, with thoſe brethren * who joined with the apoſtles and elders at Jeruſalem in determining the important queſtion concerning the neceſſity of impoſing upon the Gentile converts the ritual obſervances of the law of Moſes. Theſe lay-elders Paul enjoined Timothy § to account worthy of double honour, if they ſhould rule well, and diſcharge the duties for which they were ſeparated from the multitude of their brethren. In the church of Scotland every pariſh has two or three of thoſe lay-elders, who are grave and ſerious perſons choſen from among the heads of families, of known orthodoxy and ſteady adherence to the worſhip, diſcipline, and government of the church. Be-

11 Governed by clergymen and laymen.

* Acts xv.

§ 1 Tim. v. 17.

ing ſolemnly engaged to uſe their utmoſt endeavours for the ſuppreſſion of vice and the cheriſhing of piety and virtue, and to exerciſe diſcipline faithfully and diligently, the miniſter, in the preſence of the congregation, ſets them apart to their office by ſolemn prayer; and concludes the ceremony, which is ſometimes called ordination, with exhorting both elders and people to their reſpective duties.

12
The kirk-ſeſſion.

The kirk-ſeſſion, which is the loweſt eccleſiaſtical judicatory, conſiſts of the miniſter and thoſe elders of the congregation. The miniſter is *ex officio* moderator, but has no negative voice over the deciſion of the ſeſſion; nor indeed has he a right to vote at all, unleſs when the voices of the elders are equal and oppoſite. He may indeed enter his proteſt againſt their ſentence, if he think it improper, and appeal to the judgment of the preſbytery; but this privilege belongs equally to every elder, as well as to every perſon who may believe himſelf aggrieved by the proceedings of the ſeſſion. The deacons, whoſe proper office it is to take care of the poor, may be preſent in every ſeſſion, and offer their counſel on all queſtions that come before it; but except in what relates to the diſtribution of alms, they have no deciſive vote with the miniſter and elders.

13
The preſbytery.

The next judicatory is the *preſbytery*, which conſiſts of all the paſtors within a certain diſtrict, and one ruling elder from each pariſh commiſſioned by his brethren to repreſent, in conjunction with the miniſter, the ſeſſion of that pariſh. The preſbytery treats of ſuch matters as concern the particular churches within its limits; as the examination, admiſſion, ordination, and cenſuring of miniſters; the licenſing of probationers, rebuking of groſs or contumacious ſinners, the directing of the ſentence of excommunication, the deciding upon references and appeals from kirk-ſeſſions, reſolving caſes of conſcience, explaining difficulties in doctrine or diſcipline; and cenſuring, according to the word of God, any hereſy or erroneous doctrine which hath been either publicly or privately maintained within the bounds of its juriſdiction. Whatever advantages may ariſe from this equality, we cannot altogether approve of that part of the conſtitution which gives an equal vote, in queſtions of hereſy, to an illiterate mechanic and his enlightened paſtor. We are perſuaded that it has been the ſource of much trouble to many a pious clergyman; who, from the laudable deſire of explaining the ſcriptures and declaring to his flock all the counſel of God, has employed a variety of expreſſions of the ſame import, to illuſtrate thoſe articles of faith, which may be obſcurely expreſſed in the eſtabliſhed ſtandards. The fact however is, that, in preſbyteries, the only prerogatives which the paſtors have over the ruling elders, are the power of ordination by impoſition of hands, and the privilege of having the moderator choſen from their body.

14
The provincial ſynod.

From the judgment of the preſbytery there lies an appeal to the provincial ſynod, which ordinarily meets twice in the year, and exerciſes over the preſbyteries within the province a juriſdiction ſimilar to that which is veſted in each preſbytery over the ſeveral kirk-ſeſſions within its bounds. Of theſe ſynods there are in the church of Scotland fifteen, which are compoſed of the members of the ſeveral preſbyteries within the reſpective provinces which give names to the ſynods.

15
The general aſſembly.

The higheſt authority in the church of Scotland is the general aſſembly, which conſiſts of a certain number of miniſters and ruling elders delegated from each preſbytery, and of commiſſioners from the univerſities and royal boroughs. A preſbytery in which there are fewer than twelve pariſhes, ſends to the general aſſembly two miniſters and one ruling elder: if it contain between 12 and 18 miniſters, it ſends three of theſe, and one ruling elder: if it contain between 18 and 24 miniſters, it ſends four miniſters and two ruling elders; and of 24 miniſters, when it contains ſo many, it ſends five with two ruling elders. Every royal borough ſends one ruling elder, and Edinburgh two; whoſe election muſt be atteſted by the kirk-ſeſſions of their reſpective boroughs. Every univerſity ſends one commiſſioner from its own body. The commiſſioners are choſen annually ſix weeks before the meeting of the aſſembly; and the ruling elders are often men of the firſt eminence in the kingdom for rank and talents. In this aſſembly, which meets once a year, the king preſides by his commiſſioner, who is always a nobleman; but he has no voice in their deliberations. The order of their proceedings is regular, though ſometimes the number of members creates a confuſion, which the moderator, who is choſen from among the miniſters to be, as it were, the ſpeaker of the houſe, has not ſufficient authority to prevent. Appeals are brought from all the other eccleſiaſtical courts in Scotland to the general aſſembly; and in queſtions purely religious no appeal lies from its determinations.—In the ſubordination of theſe aſſemblies, parochial, preſbyterial, provincial, and national, the leſs unto the greater, conſiſts the external order, ſtrength, and ſtedfaſtneſs of the church of Scotland.

PRESCIENCE, in theology, previſion, or foreknowledge; that knowledge which God has of things to come.—The doctrine of predeſtination is founded on the preſcience of God, and on the ſuppoſition of all futurity's being preſent to him. See Predeſtination.

PRESCRIPTION, in medicine, is the aſſigning a proper and adequate remedy to the diſeaſe, from an examination of its ſymptoms, and an acquaintance with the virtues and effects of the materia medica.

Preſcription, in law, is a title acquired by uſe and time, and allowed by law; as when a man claims any thing, becauſe he, his anceſtors, or they whoſe eſtate he hath, have had or uſed it all the time whereof no memory is to the contrary: or it is where for continuance of time, *ultra memoriam hominis*, a particular perſon hath a particular right againſt another.

There is a difference between preſcription, cuſtom, and uſage. *Preſcription* hath reſpect to a certain perſon, who *by intendment* may have continuance *for ever;* as for inſtance, he and all they *whoſe eſtate he hath* in ſuch a thing, this is a preſcription: but, *Cuſtom*, is *local*, and always applied to a *certain* place; as, *time out of mind there has been ſuch a cuſtom in ſuch a place*, &c. And *preſcription* belongeth to *one* or a *few* only; but *cuſtom* is common to *all*. *Uſage* differs from both, for it may be either to *perſons* or *places;* as to *inhabitants of a town to have a way*, &c.

A cuſtom and preſcription are in the *right;* uſage is in the *poſſeſſion*; and a preſcription that is good for the matter and ſubſtance, may be bad by the manner of ſetting it forth: but where that which is claimed *as a cuſtom*, in or for many, will be good, *that* regularly will be ſo when claimed by *preſcription* for one. *Preſcription* is to be *time out of mind;* though it is not the length of time that begets the right of preſcription, nothing being done by time, although every thing is done in time; *but it is a preſumption in law, that a thing cannot continue ſo long quiet, if it was againſt right, or injurious to another.*

PRESCRIPTION, in Scotch law. See LAW, p. 698, and 725.

PRESCRIPTION, in theology, was a kind of argument pleaded by Tertullian and others in the 3d century againſt erroneous doctors. This mode of arguing has been deſpiſed by ſome, both becauſe it has been uſed by Papiſts, and becauſe they think that truth has no need of ſuch a ſupport.

PRESENCE, a term of relation, uſed in oppoſition to abſence, and ſignifying the exiſtence of a perſon in a certain place.

PRESENT Tenſe, in grammar, the firſt tenſe of a verb, expreſſing the preſent time, or that ſomething is now performing; as *ſcribo,* I write, or am writing. See GRAMMAR.

PRESENTATION, in eccleſiaſtical law. See PATRONAGE.

PRESENTATION of the Virgin, is a feaſt of the Romiſh church, celebrated on the 21ſt of November, in memory of the Holy Virgin's being preſented by her parents in the temple, to be there educated. Emanuel Comnenus, who began to reign in 1143, makes mention of this feaſt in his Conſtitution. Some imagine it to have been eſtabliſhed among the Greeks in the 11th century; and think they ſee evident proofs of it in ſome homilies of George of Nicomedia, who lived in the time of Photius. Its inſtitution in the Weſt is aſcribed to Gregory XI. in 1372. Some think it was inſtituted in memory of the ceremony practiſed among the Jews for their new-born females; correſponding to the circumciſion on the eighth day for males.

PRESENTATION of our Lady alſo gives the title to three orders of nuns. The firſt, projected in 1618, by a maid named Joan of Cambray. The habit of the nuns, according to the viſion ſhe pretended to have, was to be a grey gown of natural wool, &c.; but this project was never accompliſhed. The ſecond was eſtabliſhed in France, about the year 1627, by Nicholas Sanguin, biſhop of Senlis; it was approved by Urban VIII. This order never made any great progreſs. The third was eſtabliſhed in 1664, when Frederic Borromeo, being apoſtolical viſitor in the Valteline, was intreated by ſome devout maids at Morbegno to allow them to live in community in a retired place; which he granted, and erected them into a congregation, under the title of *congregation of our Lady.* They live under the rule of St Auguſtine.

PRESENTMENT, in law. See PROSECUTION.

A preſentment, generally taken, is a very comprehenſive term; including not only *preſentments* properly ſo called, but alſo inquiſitions of office, and indictments by a grand jury. A preſentment, properly ſpeaking, is the notice taken by a grand jury of any offence from their own knowledge or obſervation, without any bill of indictment laid before them at the ſuit of the king: As the preſentment of a nuiſance, a libel, and the like; upon which the officer of the court muſt afterwards frame an indictment, before the party preſented can be put to anſwer it. An inquiſition of office is the act of a jury, ſummoned by the proper officer to inquire of matters relating to the crown, upon evidence laid before them. Some of theſe are in themſelves convictions, and cannot afterwards be traverſed or denied; and therefore the inqueſt, or jury, ought to hear all that can be alleged on both ſides. Of this nature are all inquiſitions of *felo de ſe;* of flight in perſons accuſed of felony; of deodands, and the like; and preſentments of petty offences in the ſheriff's tourn or court-leet, whereupon the preſiding officer may ſet a fine. Other inquiſitions may be afterwards traverſed and examined; as particularly the coroner's inquiſition of the death of a man, when it finds any one guilty of homicide; for in ſuch caſes the offender ſo preſented muſt be arraigned upon this inquiſition, and may diſpute the truth of it; which brings it to a kind of indictment, the moſt uſual and effectual means of proſecution. See INDICTMENT.

PRESIDENT, PRÆSES, is an officer created or elected to preſide over a company or aſſembly; ſo called in contradiſtinction to the other members, who are termed *reſidents.*

PRESIDENT of the United States of America. The officer in whom the executive power is veſted by the conſtitution. He muſt be a natural born citizen of the United States, he muſt be at leaſt thirty five years of age, and have reſided fourteen years in the United States. He is choſen by electors appointed by the different States, equal in number to the Senators and Repreſentatives in Congreſs, whoſe votes, ſealed up, are tranſmitted to the Preſident of the Senate, who opens and counts them in preſence of the whole Congreſs, and the whole majority of votes decides. He holds his office for four years, and is commander in chief of the army and navy of the United States, and of the militia when called into the actual ſervice of the United States; and by and with the conſent of the Senate he has power to appoint ambaſſadors and other public miniſters; he can fill up vacancies which happen during the receſs of the Senate; he can convene and adjourn the Congreſs; receive ambaſſadors; take care that the laws be faithfully executed; and commiſſion all the officers of the United States: but like all the officers of the United States, he ſhall be removed from office on impeachment for, and conviction of, treaſon, bribery or other high crimes and miſdemeanors.

Vice-PRESIDENT of the United States, is choſen by the electors at the ſame time and in the ſame manner with the Preſident. See above. He is the Preſident of the Senate, but has no vote unleſs they be equally divided. The powers and duties of the Preſident of the United States devolve on him in caſe of the removal of the Preſident until a new Preſident be elected.

PRESS (PRELUM), in the mechanic arts, a machine made of iron or wood, ſerving to ſqueeze or compreſs any body very cloſe.

The ordinary preſſes conſiſt of ſix members, or pieces; viz. two flat ſmooth planks; between which the things to be preſſed are laid; two ſcrews, or worms, faſtened to the lower plank, and paſſing through two holes in the upper; and two nuts, in form of an S, ſerving to drive the upper plank, which is moveable, againſt the lower, which is ſtable, and without motion.

PRESSES uſed for expreſſing of Liquors, are of various kinds; ſome, in moſt reſpects, the ſame with the common preſſes, excepting that the under plank is perforated with a great number of holes, to let the juice expreſſed run through into a tub, or receiver, underneath.

A very uſeful machine for a preſs, in the proceſs of cyder-making, has been lately conſtructed by Mr Anſtice, who, with his well-known zeal for the improvement of mechanics, permits us to lay before our readers the following deſcription of it.

Plate CCCCXV.

AA, nº 1. two pieces of timber, 21 feet long, 12 by 6 inches, laid ſide by ſide at the diſtance of 12 inches, and ſecured in that ſituation by blocks placed between and bolts paſſing through them; this frame forms the bed of the machine. BB, two uprights, 12 feet long, 6 by 8 inches, morticed upon them, and ſecured in their poſition by pins and iron ſquares. CC, two uprights, five feet long, ſix by 10 inches, morticed near the end of the under frame, and ſecured as before. D, a lever, 17 feet long, 12 by 13 inches, turning on a large bolt which paſſes through the ſhort uprights, alſo through iron ſtraps, which ſecure them to the bed inſide, and a ſtirrup of iron which paſſes over the end of the lever, and which makes the turning point in the line of its lower ſide, and not through its middle. E, a lever 20 feet long, ſix by eight inches at its largeſt part, and tapering towards the other end: this lever turns on a bolt in the uprights BB. F. 1, 2, 3, 4. four pieces of oak (which he calls *needles*, 10 feet long), four by two and an half inches, morticed looſely into the upper lever, and hung thereto by bolts, ſo as to ſwing perpendicularly, and play in a long mortice or channel cut through the large lever to receive them. Theſe needles have inch-holes pretty cloſely bored through them (in a direction croſſing the machine), from the lower ends, as far upwards as the great lever will reach, when it is as high as it can go. G, a bed to receive what is to be preſſed. H, a frame to ſupport a winch worked by a handle at I. At the end of the ſmall lever two blocks or pulleys are fixed, one above and the other below it; a rope of about half an inch diameter is then faſtened to the cieling (or continuation of the uprights of the winch frame if neceſſary) at K; then paſſed through the upper block on the lever, from thence paſſed through a block at L, and then goes with four turns round the winch, from whence it is carried through the block under the lever, and faſtens to the machine at M; by this means, if the winch be turned one way, it raiſes the end of the ſmall lever if the other depreſſes it.

To work the machine. If we ſuppoſe the great lever bearing on the matter to be preſſed, an iron pin muſt be put into one of the holes in the needles above the great lever; and when the ſmall lever is worked as far as it will go, either up or down, another bolt is to be put into the hole, which comes neareſt above the great lever on the other ſide of the uprights BB, and the winch then turned the contrary way, by which means the preſſing goes on whether the ſmall lever riſes or falls. Before the reſiſtance is very great, the needles fartheſt from the fulcrum of the ſmall lever are uſed; after that the neareſt are employed, which doubles the power of the machine. In raiſing the great lever, or lowering it to its bearing, the needles moſt diſtant from the fulcrum of the ſmall lever, are uſed *under* inſtead of *over* it. As the rope is liable to ſtretch and get ſlack, he paſſes it, after taking two turns on the winch, through a pulley, to which is ſuſpended a weight of half a hundred, and then takes two turns more before it is carried through the other block, by which means the ſlack is conſtantly gathered in, and the weight holds on without increaſing the friction, as by hanging under the winch it counteracts the preſſure upwards on its axis.

The power of this machine is very great, being as 1 to 1136 nearly, and capable by a trifling addition of any other proportion. It is applicable to many purpoſes beſide cyder-preſſing, and is more ſimple, and leſs liable to injury, than any other which has fallen under our obſervation. Perhaps, however, it would be an improvement to uſe, inſtead of the ropes and pulleys, by which the lever E is moved, a ſmall wheel or pinion of 10 or 12 teeth, on the axis of the winch W (nº 2.), and a ſtiff beam *e n* down from the lever, having on its lower end an iron rack, of which the teeth take into thoſe of the pinion. The action of theſe teeth would, in our opinion, be leſs diminiſhed by friction and obliquity, than the pulleys are by friction and the ſtiffneſs of the rope; and the machine would retain all its other advantages.

Press *uſed by Joiners*, to keep cloſe the pieces they have glued, eſpecially panels, &c. of wainſcot, is very ſimple, conſiſting of four members; viz. two ſcrews, and two pieces of wood, four or five inches ſquare, and two or three feet long; whereof the holes at the two ends ſerve for nuts to the ſcrews.

Press *uſed by Inlayers*, reſembles the joiner's-preſs, except that the pieces of wood are thicker, and that only one of them is moveable; the other, which is in form of a treſſel, being ſuſtained by two legs or pillars, jointed into it at each end. This preſs ſerves them for ſawing and cleaving the pieces of wood required in marquetry or inlaid work.

Founder's Press, is a ſtrong ſquare frame, conſiſting of four pieces of wood, firmly joined together with tenons, &c. This preſs is of various ſizes, according to the ſizes of the moulds; two of them are required to each mould, at the two extremes whereof they are placed; ſo as that, by driving wooden wedges between the mould and the ſides of the preſſes, the two parts of the mould wherein the metal is to be run may be preſſed cloſe together.

*Printing-*Press. See Printing-*Preſs*.

*Rolling-*Press, is a machine uſed for the taking off prints from copper-plates. It is much leſs complex than that of the letter-printers. See its deſcription and uſe under the article *Rolling-preſs* Printing.

Press, in *Coining*, is one of the machines uſed in ſtriking of money; differing from the balance, in that it has only one iron bar to give it motion, and preſs the moulds or coins; is not charged with lead at its extreme, nor drawn by cordage. See Coining.

*Binder's Cutting-*Press, is a machine uſed equally by book-binders, ſtationers, and paſteboard-makers; conſiſting of two large pieces of wood, in form of cheeks, connected by two ſtrong wooden ſcrews; which, being turned by an iron bar, draw together, or ſet aſunder, the cheeks, as much as is neceſſary for the putting in the books or paper to be cut. The cheeks are placed lengthwiſe on a wooden ſtand, in the form of a cheſt, into which the cuttings fall. Aſide of the cheeks are two pieces of wood, of the ſame length with the ſcrews, ſerving to direct the cheeks, and prevent their opening unequally. Upon the cheeks the plough moves, to which the cutting knife is faſtened by a ſcrew; which has its key, to diſmount it, on occaſion, to be ſharpened.

The plough conſiſts of ſeveral parts; among the reſt a wooden ſcrew or worm, which, catching within the nuts of the two feet that ſuſtain it on the cheeks, brings the knife to the book or paper which is faſtened in the preſs between two boards. This ſcrew, which is pretty long, has two directories, which reſemble thoſe of the ſcrews of the preſs. To make the plough ſlide ſquare and even on the cheeks, ſo that the knife may make an equal paring, that foot of the plough where the knife is not fixed, ſlides in a kind of groove, faſtened along one of the cheeks. Laſtly, the knife is a piece of ſteel, ſix or ſeven inches long, flat, thin, and ſharp, terminating at one end in a point, like that of a ſword, and at the other in a ſquare form, which ſerves to faſten it to the plough. See *Book-Binding*.

As the long knives uſed by us in the cutting of books or papers, are apt to jump in the cutting thick books, the Dutch are ſaid to uſe circular knives, with an edge all round; which not only cut more ſteadily, but laſt longer without grinding.

Press, in the *Woollen Manufactory*, is a large wooden machine, ſerving to preſs cloths, ſerges, rateens, &c. thereby to render them ſmooth and even, and to give them a gloſs.

This machine conſiſts of ſeveral members; the principal whereof are the cheeks, the nut, and the worm or ſcrew, accompanied with its bar, which ſerves to turn it round, and make it deſcend perpendicularly on the middle of a thick wooden plank, under which the ſtuffs to be preſſed are placed. The calender is alſo a kind of preſs, ſerving to preſs or calender linens, ſilks, &c.

Liberty of the Press. See *Liberty of the Preſs*.

PRESSING, in the manufactures, is the violently ſqueezing a cloth, ſtuff, &c. to render it ſmooth and gloſſy.

There are two methods of preſſing, viz. cold and hot.

As to the former, or cold preſſing: After the ſtuff has been ſcoured, fulled, and ſhorn, it is folded ſquare in equal plaits, and a ſkin of vellum or paſteboard put between each plait. Over the whole is laid a ſquare wooden plank, and ſo put into the preſs, which is ſcrewed down tight by means of a lever. After it has lain a ſufficient time in the preſs, they take it out, removing the paſteboards, and lay it up to keep. Some only lay the ſtuff on a firm table after plaiting and paſteboarding, cover the whole with a wooden plank, and load it with a proper weight.

The method of preſſing hot is this: When the ſtuff has received the above preparations, it is ſprinkled a little with water, ſometimes gum-water; then plaited equally, and between each two plaits are put leaves of paſteboard; and between every ſixth and ſeventh plait, as well as over the whole, an iron or braſs plate well heated in a kind of furnace. This done, it is laid upon the preſs, and forcibly ſcrewed down. Under this preſs are laid five, ſix, &c. pieces at the ſame time, all furniſhed with their paſteboards and iron-plates. When the plates are well cooled, the ſtuffs are taken out and ſtitched a little together to keep them in the plaits. This manner of preſſing was only invented to cover the defects of the ſtuffs; and, accordingly, it has been frequently prohibited.

Pressing, or *Impreſſing*. See Impressing.

PRESSION, or pressure, in the Carteſian Philoſophy, is a ſuppoſed impulſive kind of motion, or rather an endeavour to move, impreſſed on a fluid medium, and propagated through it.

PRESSURE of air. See Pneumatics.

Pressure of Fluids. See Hydrostatics and Pneumatics.

PREST, is uſed for a duty in money, to be paid by the ſheriff on his account, in the exchequer, or for money left or remaining in his hands: 2 & 3 Edw. VI. c. 4.

Prest-Money, is ſo called from the French word *preſt*, that is, *promptus, expeditus*; for that it binds thoſe who receive it, to be ready at all times appointed, being commonly meant of ſoldiers.

PRESTATION-money, is a ſum of money paid yearly by archdeacons and other dignitaries to their biſhop, *pro exteriori juriſdictione*.

Prestation (*præſtatio*), was anciently uſed for other payments: *Et quieti ſint de præſtatione muragii.* Chart. Hen. VII. Sometimes alſo for pourveyance.

PRESTEIGN is a town in Radnorſhire, diſtant 149 miles weſt-north-weſt from London, in the direct road to Aberyſtwith, and throughout South Wales, in N. Lat. 52° 12', bounded to the north, and north eaſt by Herefordſhire. It is a neat well built town, with clean and regular ſtreets, and is the reſidence of many genteel families. The neighbourhood abounds with all the comforts and conveniencies of life. It is ſeated on a gravelly ſoil on the banks of the river Lug, and at the head of a very fertile vale: the mountains to the weſt and north-weſt of the town forming, as it were, an amphitheatre round it. The name of it in Welſh is *Slan-Andras*, which is ſuppoſed to be derived from the church, which is dedicated to Saint Andrew. The town is divided into four wards, which have each a ſeparate juriſdiction, ſeparate officers, levies, &c. The curfew-bell of William the Conqueror ſtill remains in this place, and is rung every night. It is a borough by preſcription, and is governed by a bailiff annually elected, and ſworn in by a ſteward appointed by the crown. The living is a rectory and vicarage united, and reported to be worth from L. 500 to L. 600 *per annum*; the pariſh lying in two counties. Here is an excellent free ſchool well endowed. The county hall, the county gaol, the country bridewell, and houſe of correction, are kept in this place. The markets are held on Saturdays; and there are two fairs in the year. About a century and a half ago Preſteign was conſiderably larger; had a good woollen manufactory, of which the very large buildings now ſtanding (formerly belonging to clothiers) bear ample teſtimony, but a fire, ſucceeded by the plague, in the town about the year 1636, reduced the ſame, and with it, its conſequence as a manufacturing town. The healthineſs of its ſituation cannot be better aſcertained than by the regiſter of births and burials. The pariſh embraces at leaſt a circle of 19 miles; and the average of burials for the laſt ſeven years was only 26 perſons *per annum*, and that of births for the ſame time was 42; and of the former upwards of 18 were from 80 to 100 years old.

PRESTER (John, or Jean), an appellation formerly given to an emperor of the Tartars who was overcome and killed by Jenghiz Khan. Since that time it has been given to the emperor of Abyſſinia or Ethiopia; however, in Ethiopia itſelf this name is utterly unknown, the emperor being there called the *grand negus*.

Prester, a meteor, conſiſting of an exhalation thrown from the clouds downwards with ſuch violence, as that by the colliſion it is ſet on fire. The word is Greek ϖρηϛηρ, the name of a kind of ſerpent; called alſo *dipſas*, to which this meteor is ſuppoſed to bear a reſemblance. The preſter differs from the thunderbolt in the manner of its inflammation; and in its burning and breaking every thing it touches with greater violence.

Prester, a word uſed by ſome to expreſs the external part of the neck, which is uſually inflated in anger.

PRESTIMONY, in canon law, is derived *a præſtatione quotidiana;* and is, by ſome, defined to be a kind of benefice, ſerved by a ſingle prieſt. Others ſay, it is the incumbency of a chapel, without any title or collation; ſuch as are moſt of thoſe in caſtles, where prayers or maſs are ſaid; and which are mere unendowed oratories. Whence the term is alſo applied, in the Romiſh church, to certain perpetual offices beſtowed on canons, religious, or others, for the ſaying of maſſes, by way of augmentation of their livings. Others think it is a leaſe, or conceſſion of any eccleſiaſtical fund or revenue, belonging to a monaſtery, to be enjoyed during life. Du Moulin calls it a *profane benefice*, which, however, has a perpetual title, and an eccleſiaſtical office, with certain revenues attached to it; which the incumbent is allowed to ſell, and which may be poſſeſſed without tonſure; ſuch as the lay church-wardens of Notre-dame. He adds, that, in propriety, the canonries of chapels are benefices of this nature. The moſt probable opinion ſeems to be, that preſtimony is a fund, or revenue, appropriated by the founder for the ſubſiſtence of a prieſt, without being erected into any title of benefice, chapel, prebend, or priory; and which is not ſubject either to the pope or to the ordinary, but whereof the patron, and thoſe who have a right from him, are the collators, and nominate and confer *pleno jure*.

PRESTO, in the Italian muſic, intimates to perform quick; as *preſtiſſimo* does extremely quick.

PRESTON, a town of Lancaſhire in England, ſeated on the river Ribble, over which there is a handſome ſtone bridge. Here is held a court of chancery, and other offices of juſtice for the county palatine of Lancaſter. It is noted for the defeat of the rebels here in 1715, when they were all made priſoners, and ſent up to London. W. Long. 2. 26. N. Lat. 53. 45.

PRESTRE. See Vauban.

PRETENSED or pretended right, in law, is where one is in poſſeſſion of lands and tenements, which another, who is out, claims and ſues for. Here the pretenſed right is in him who ſo claims or ſues.

PRETERITE, in grammar, a tenſe which expreſſes the time paſt, or an action completely finiſhed; as, *ſcripſi*, "I have written." See Perfect and Grammar.

PRETERITION, or pretermission, in rhetoric, a figure whereby, in pretending to paſs over a thing untouched, we make a ſummary mention thereof. *I will not ſay he is valiant, he is learned, he is juſt*, &c. The moſt artful praiſes are thoſe given by way of preterition. See Oratory.

PRETEXT, a colour or motive, whether real or feigned, for doing ſomething.

Toga **PRETEXTA**, among the ancient Romans, a long white gown, with a border of purple round the edges, and worn by children of quality till the age of puberty, *viz.* by the boys till 17, when they changed it for the *toga virilis:* and by the girls till marriage.

PRETIUM sepulchri, in old law books, &c. thoſe goods accruing to the church wherein a corps is buried. In the Iriſh canons, lib. xix. cap. 6. it is ordered, that along with every body that is buried, there go his cow, horſe, apparel, and the furniture of his bed; none of which may be diſpoſed of otherwiſe than for the payment of debts, &c. as being familiars and domeſtics of the deceaſed.

PRETOR, a magiſtrate among the ancient Romans, not unlike the lord chief juſtices, or lord chancellor in England, or both in one; as being veſted with the power of diſtributing juſtice among the citizens. At firſt there was only one pretor; but afterwards, another being created, the firſt or chief one had the title of *prætor urbanus*, or the "city pretor:" the other was called *peregrinus*, as being judge in all matters relating to foreigners. But, beſides theſe, there were afterwards created many provincial pretors; who were not only judges, but alſo aſſiſted the conſuls in the government of the provinces, and even were inveſted with the government of provinces themſelves.

PRETORIAN guards, in Roman antiquity, were the emperor's guards, who at length were increaſed to 10,000: they had this denomination, according to ſome, from their being ſtationed at a place called *Prætorium:* their commander was ſtyled *præfectus prætorii.*

PRETORIUM, or Prætorium, among the Romans, denoted the hall or court wherein the pretor lived, and wherein he adminiſtered juſtice.

It likewiſe denoted the tent of the Roman general, wherein councils of war, &c. were held: alſo a place in Rome where the Pretorian guards were lodged.

PREVARICATION, in the civil law, is where the informer colludes with the defendants, and ſo makes only a ſham proſecution.

Prevarication, in our laws, is when a man falſely ſeems to undertake a thing, with intention that he may deſtroy it; where a lawyer pleads booty, or acts by colluſion, &c.

It alſo denotes a ſecret abuſe committed in the exerciſe of a public office, or of a commiſſion given by a private perſon.

PRIAM, king of Troy, was the ſon of Laomedon, He was carried into Greece after the taking of that city by Hercules; but was afterwards ranſomed, on which he obtained the name of *Priam*, a Greek word ſignifying "ranſomed." At his return he rebuilt Ilium, and extended the bounds of the kingdom of Troy, which became very flouriſhing under his reign. He married Hecuba, the daughter of Ciſſeus king of Thrace, by whom he had 19 children; and among the reſt Paris, who

Priapiſmus
‖
Price.

who carried off Helen, and occaſioned the ruin of Troy, which is ſuppoſed to have been ſacked by the Greeks about 1184 B. C. when Priam was killed by Pyrrhus the ſon of Achilles at the foot of an altar where he had taken refuge, after a reign of 52 years. See TROY.

PRIAPISMUS, or PRIAPISM, is an erection of the penis without any concomitant pain, or the conſent of other parts. It is thus called, becauſe the perſon in this ſtate reſembles the lewd god Priapus. Cœlius Aurelianus ſays it is a palſy of the ſeminal veſſels, and other nerves diſtributed to the parts about the penis, by the diſtenſion of which this diſorder is produced. It is of the ſame nature as the ſatyriaſis. See MEDICINE, n° 372.

PRIAPUS, in Pagan worſhip, the ſon of Bacchus and Venus, who preſided over gardens and the moſt indecent actions. He was particularly adored at Lampſacus, a city at the mouth of the Helleſpont, ſaid to be the place of his birth; and his image was placed in gardens to defend them from thieves and birds deſtructive to fruit. He was uſually repreſented naked, with a ſtern countenance, matted hair, and holding either a wooden ſword or ſickle in his hand, and with a monſtrous privity; from whence downward his body ended in a ſhapeleſs trunk. The ſacrifice offered to this obſcene deity was the aſs; either on account of the natural uncomelineſs of this animal, and its propenſity to venery, or from the diſappointment which Priapus met with on his attempting the chaſtity of Veſta, while that goddeſs was aſleep, when ſhe eſcaped the injury deſigned her by her being awaked by the braying of old Silenus's aſs.

PRICE (Rev. Richard), D. D. L L. D. fellow of the Royal Society of London, and of the Academy of Sciences, New England, was born at Tynton in Glamorganſhire, February 22, 1723. His father was a diſſenting miniſter at Bridgend in that country, and died in 1739. At eight years old he was placed under a Mr Simmons of Neath; and in four years removed to Pentwyn in Caermarthenſhire under the Rev. Samuel Jones, whom he repreſented as a man of a very enlarged mind, and who firſt inſpired him with liberal ſentiments of religion. Having lived as long with him as with Mr Simmons, he was ſent to Mr Griffith's academy at Talgarth in Breconſhire. In 1740 he loſt his mother; and on this he quitted the academy and came to London. Here he was ſettled at that academy, of which Mr Eames was the principal tutor, under the patronage of his uncle the Rev. S. Price, who was copaſtor with Dr Watts upwards of 40 years. At the end of four years he left this academy, and reſided with Mr Streatfield of Stoke Newington in the quality of domeſtic chaplain, while at the ſame time he regularly aſſiſted Dr Chandler at the Old Jewry, and occaſionally aſſiſted others. Having lived with Mr Streatfield near 13 years, on his death and his uncle's he was induced to change his ſituation, and in 1757 married Miſs S. Blundell of Leiceſterſhire. He then ſettled at Hackney, but being ſhortly after choſen miniſter at Newington Green, he lived there until the death of his wife, which was in 1786, when he returned to Hackney. He was next choſen afternoon-preacher at the meeting-houſe in Poor Jewry-ſtreet, but this he reſigned on being elected paſtor of the Gravel-pit meeting Hackney, and afternoon-preacher at Newington Green. Theſe he reſigned with a farewel-ſermon in February 1791. Shortly after he was attacked with a nervous fever, which diſappearing was ſucceeded by a diſorder in his bladder, which reduced him to ſuch a degree that, worn out with agony and diſeaſe, he died without a groan on the 19th April 1791. He left his property to a ſiſter and two nephews.

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Dr Kippis, ſpeaking of his learning and purſuits, obſerves*, that "his chief aim was to lay a foundation for ſolid knowledge, by an application to ſciences of the nobleſt kind. It was on the great and fundamental principles and obligations of morality, on the higher ſpecies of mathematics, on the ſublimer parts of natural philoſophy, on the true baſis of government, and on the queſtions which relate to the eſſential welfare and dignity of man, that his ſtudies were employed; and in the proſecution of theſe ſtudies he not only enriched his own mind, but was enabled to become of eminent ſervice to his country and to the world. In his moral writings he has laboured with diſtinguiſhed ability to build the ſcience of ethics on an immutable baſis; and what he has advanced will always ſtand high in eſtimation as one of the ſtrongeſt efforts of human reaſon in favour of the ſyſtem he has adopted. For myſelf (adds Dr Kippis), I ſcruple not to ſay, that I regard the treatiſe referred to as a rich treaſure of valuable information, and as deſerving to be ranked among the firſt productions of its kind. With reſpect to his other ethical works, every one muſt admire the zeal, earneſtneſs, and ſtrength, with which he endeavours to lead men into pious views of God, of providence and prayer; and to promote the exerciſe of devout and amiable diſpoſitions. In conſequence of his profound knowledge in mathematical calculations, he was qualified at a particular criſis for being of ſingular utility to his fellow-citizens. A number of ſchemes for inſurance for lives, and the benefit of ſurvivorſhip, promiſing mighty advantages, were riſing up in the metropolis. Theſe ruinous ſchemes would have been carried to great exceſs had not Dr Price ſtepped forward and diſpelled the deluſion. Gratitude will not allow us to forget the ability and ſpirit with which he awakened the attention of his countrymen to the reduction of the national debt. With him it was that the ſcheme of the preſent miniſter for that purpoſe is underſtood to have originated. What crowned the whole of his character was, its being an aſſemblage of the moſt amiable and excellent private virtues. His piety was ſincere, humble, and fervent; his ſoul pure and elevated; in his views diſintereſted and noble; and in his manners mild and gentle: the applauſe of his talents and virtues will be tranſmitted to future ages, and he will be united in the catalogue with the moſt eminent benefactors of mankind."

This is the panegyric of a friend; but with few abatements it will be admitted by every candid reader. In morals Dr Price's principles were thoſe of Cudworth and Clarke; and by many who have themſelves adopted a very different theory, he is allowed to have defended thoſe principles with greater ability than any other writer in the Engliſh language (ſee *MORAL Philoſophy*, n° 14.) In metaphyſics he was perhaps too great an admirer of Plato, from whom he has borrowed a doctrine concerning ideas which we confeſs ourſelves unable to comprehend. He was a firm believer in the immateriality of the ſoul; but, with Dr Law, the late learned biſhop of Carliſle, he thought, that from death to the reſurrection of the body it remains in a dormant or

* Addreſs at his Funeral, 8vo.

quieſcent ſtate. He contended for its indiviſibility, but maintained at the ſame time its extenſion; which furniſhed Dr Prieſtley with ſome advantages in their celebrated controverſy, which his own acuteneſs would never have obtained. In propagating his political principles, which were republican, he ſometimes expreſſed himſelf with undue vehemence; and he was a zealous enemy to all religious eſtabliſhments which, in his opinion, encroach upon that liberty wherewith Chriſt has made us free. His faith reſpecting the Son of God was what has been called ſometimes *low Arianiſm* and ſometimes *Semi-arianiſm*. From a very early age he claimed the privilege of thinking for himſelf on every ſubject. His father was a rigid Calviniſt, and ſpared no pains to inſtil his own theological dogmas into the tender mind of his ſon; but young Richard would often ſtart his doubts and difficulties, and ſometimes incur the old man's diſpleaſure by arguing againſt his favourite ſyſtem with an ingenuity that perplexed, and a ſolidity that could not be eaſily overturned. He had once the misfortune to be caught reading a volume of Clarke's ſermons, which his father in great wrath ſnatched from him and threw into the fire. Perhaps he could not have taken a more effectual method to make the book a favourite, or to excite the young man's curioſity after the other works of the ſame author; and it is by no means improbable that this orthodox bigotry contributed more than any other circumſtance to lay the foundation of his ſon's Arianiſm.

But whatever may be thought of Dr Price's ſpeculative opinions, whether political or religious, his virtues in private life have never been called in queſtion. Of his practical religion it is impoſſible to ſpeak in terms too high. There was a fervour even in his public prayers which indicated the ſtrongeſt ſenſibility as well as ſincerity in himſelf, and communicated its warmth to thoſe who joined with him. But in his family devotions he gave ſtill fuller ſcope to the pious emotions of his ſoul, and proved to thoſe friends who were occaſionally preſent at them how deeply he felt religious impreſſions, and how happily he blended in this as well as in other things the cool deciſions of the underſtanding with the amiable and exalted ſenſibilities of the heart.

But it was not in devotion only that theſe ſenſibilities were diſplayed. He was as exemplary in affection to his relatives as in love to his Maker. Of this he gave a ſtriking though private inſtance before he firſt quitted his native place to try his fortune in London. His father had left to an elder brother by a former marriage a very conſiderable fortune; to Richard he left a mere trifle; and to each of two ſiſters ſtill leſs. Our author divided his ſhare between his ſiſters, reſerving to himſelf only a few pounds to defray the expences of his journey, and truſting for his future ſupport to the bleſſing of God upon his talents and his induſtry. As in early life he was an affectionate and generous brother, in old age he was a loving and attentive huſband. His wife, who for a conſiderable time before her death was almoſt wholly helpleſs, found during the laſt years of her life hardly any enjoyment except in a game at whiſt; and though our Doctor diſliked cards as a waſte of time, and never touched them on any other occaſion, to amuſe her he would ſit down every evening to the card-table, and play till it was late, with a cheerfulneſs and good humour which charmed every perſon who had the happineſs of viewing him in that endearing ſituation.

Yet, though thus attentive to the obligations of domeſtic life, he did not ſuffer his private affections to encroach upon his ſocial duties. His talents and his labours were ever ready at the call of friendſhip; nay, ſo much did his nature abound with the milk of human kindneſs, that he could not reſiſt without extreme reluctance even troubleſome and unreaſonable ſolicitations. His hours of ſtudy and retirement were frequently broken in upon by applications for aſſiſtance and advice, eſpecially matters relating to annuities and life inſurances; and in this way he ſacrificed much of his perſonal convenience to individuals of whom he knew but little, and from whom he would accept of no pecuniary recompenſe. His good nature in this reſpect amounted almoſt to a foible; and ſubjected him to importunities and loſs of time, of which he would ſometimes complain as interfering materially with more important and more generally uſeful ſtudies.

Whilſt he thus obliged the rich by his mental talents, he ſuccoured the poor with his earthly ſubſtance. A fifth part of his annual income was regularly devoted to charitable purpoſes; and he was laudably anxious to diſtribute it in ſuch a way as might produce the greateſt good. In the practice of this, and indeed of all his virtues, he was utterly devoid of oſtentation. Simplicity and humility were among the ſtrong features of his character. No man was ever leſs ſenſible of his own excellence, or leſs elated by his own celebrity; and in no man was the dignity of artleſs manners and unaffected modeſty more happily diſplayed.

His face was the true index of his mind. It beamed with philanthropy; and when lighted up in converſation with his friends, aſſumed an aſpect peculiarly pleaſing. His perſon was ſlender, and rather below the common ſize, but poſſeſſed of great muſcular ſtrength and remarkable activity. A habit of deep thought had given a ſtoop to his figure, and he generally walked a briſk pace with his eyes on the ground, his coat buttoned, one hand in his pocket, and the other ſwinging by his ſide.

It is natural to ſuppoſe that ſuch a man as Dr Price, ſome of whoſe writings were tranſlated into foreign languages, would be very generally reſpected in the republic of letters, and have many correſpondents. The ſuppoſition is well founded. In 1763 or 1764 he was choſen a fellow of the Royal Society, and contributed largely to the tranſactions of that learned body; in 1769 he received from Aberdeen a diploma creating him DD.; and in 1783 the degree of LL.D. was conferred upon him by the college of Yale in Connecticut. As in 1770 he had refuſed an American degree which had been conveyed to him by Dr Franklin, his acceptance of one 13 years afterwards can be attributed only to his very great regard for a republican form of government; which was a peculiar trait in his character, and ſhows what ſtrong attachments the vigorous mind will imbibe by thinking always on the ſame ſubjects, and in the ſame track. Among his correſpondents, the moſt eminent in his own country were the late Lord Chatham, Lord Stanhope, Lord Lanſdowne, the late biſhops of Carliſle and St Aſaph, and the preſent biſhop of Landaff; Mr Hume, Mr Harris of Saliſbury,

liſbury, Dr Gregory of Edinburgh, and the celebrated Mr Howard, who lived with him on terms of the greateſt intimacy; in America he correſponded with Dr Franklin, Dr Chauncey, Mr Adams, and others; and in France with the celebrated Turgot, the Duke de Rochefoucault, and ſeveral of the firſt national aſſembly. One of his female correſpondents ſketched his character with great juſtneſs many years ago under the fictitious but well applied name of *Simplicius*; and with this character we ſhall cloſe theſe ſhort memoirs.

"While the vain man is painfully ſtriving to outſhine the company and to attract the admiration by falſe wit, forced compliments, and ſtudied graces, he muſt ſurely be mortified to obſerve how conſtantly Simplicius engages their attention, reſpect, and complacency, without having once thought of himſelf as a perſon of any conſequence among them. Simplicius imparts his ſuperior knowledge, when called upon, as eaſily and naturally as he would tell you what it is o'clock; and with the ſame readineſs and good will informs the moſt ignorant or confers with the moſt learned. He is as willing to receive information as to give it, and to join the company, as far as he is able, in the moſt trifling converſation into which they may happen to fall as in the moſt ſerious and ſublime. If he diſputes, it is with as much candour on the moſt important and intereſting as on the moſt inſignificant ſubjects; and he is not leſs patient in hearing than in anſwering his antagoniſt. If you talk to him of himſelf or his works, he accepts praiſe or acknowledges defects with equal meekneſs, and it is impoſſible to ſuſpect him of affectation in either. We are more obliged by the plain unexaggerated expreſſions of his regard, than by the compliments and attentions of the moſt accompliſhed pattern of high breeding; becauſe his benevolence and ſincerity are ſo ſtrongly marked in every look, word, and action, that we are convinced his civilities are offered for our ſakes, not for his own, and are the natural effects of real kindneſs, not the ſtudied ornaments of behaviour. Every one is deſirous to ſhow him kindneſs in return, which we know will be accepted juſt as it is meant. All are ready to pay him that deference which he does not deſire, and to give him credit for more than he aſſumes, or even more than he poſſeſſes. With a perſon ungraceful, and with manners unpoliſhed by the world, his behaviour is always proper, eaſy, and reſpectable; as free from conſtraint and ſervility in the higheſt company, as from haughtineſs and inſolence in the loweſt. His dignity ariſes from his humility; and the ſweetneſs, gentleneſs, and frankneſs of his manners, from the real goodneſs and rectitude of his heart, which lies open to inſpection in all the fearleſsneſs of truth, without any need of diſguiſe or ornament."

Such was Dr Price.—Of his public principles men will think differently; of his private worth there can be but one opinion. He will live in the memory of his friends till memory has loſt her power. To poſterity his works will be his monument. They are: A Review of the principal Queſtions and Difficulties in Morals, 8vo, 1758; Diſſertations on Providence, &c. 8vo, 1767; Obſervations on Reverſionary Payments, &c. 8vo, 1771; Appeal on the National Debt, &c. 8vo, 1773; Obſervations on the Nature of Civil Liberty, 1776; on Materialiſm and Neceſſity, in a correſpondence between Dr Price and Dr Prieſtley, 1779; on Annuities, Aſſurances, Population, &c. 8vo, 1779; on the Population of England, 1780; on the Public Debts, Finances, Loans, &c. 8vo, 1783; on Reverſionary Payments, 2 vols, 1783; on the importance of the American Revolution, 1784: beſides Sermons, and a variety of papers in the Philoſophical Tranſactions on aſtronomical and other philoſophical ſubjects.

PRIDE, inordinate and unreaſonable ſelf-eſteem, attended with inſolence and rude treatment of others.—It is frequently confounded with vanity, and ſometimes with dignity; but to the former paſſion it has no reſemblance, and in many circumſtances it differs from the latter. Vanity is the parent of loquacious boaſting; and the perſon ſubject to it, if his pretences be admitted, has no inclination to inſult the company. The proud man, on the other hand, is naturally ſilent, and, wrapt up in his own importance, he ſeldom ſpeaks but to make his audience feel their inferiority. It is this circumſtance which diſtinguiſhes pride from dignity, and conſtitutes its ſinfulneſs. Every man poſſeſſed of great powers of mind is conſcious of them, and feels that he holds a higher rank in the ſcale of exiſtence than he whoſe powers are leſs. If he recollect, at the ſame time, that he has nothing which he did not receive, and that his ſuperiority is owing to the good pleaſure of Him who forms his creatures differently, as the potter forms his clay; he will be ſo far from inſulting his inferiors, that when neceſſarily in company with them, he will bear with their foibles, and, as far as is proper, make them loſe ſight of the diſtance which the laws of God and man have for ever placed between them and him. This condeſcenſion, however, if he be a man of dignity, will never lead him to join with them in any mean or dirty action. He will even excuſe in them many things which he would condemn in himſelf, and give them his good wiſhes, after they have forfeited his eſteem. Such a character is amiable and reſpectable, and what every man ſhould labour to obtain. From the weakneſs of human nature, however, it is too apt to degenerate into pride.

To a man of great intellectual powers and various erudition, the converſation of ordinary perſons affords neither inſtruction nor amuſement; and ſuch converſation, when often repeated, muſt, from the nature of things, become tedious and irkſome. But it requires great command of temper and of manners to prevent uneaſineſs long felt from ſometimes betraying itſelf by external ſymptoms, ſuch as peeviſh expreſſions, a forbidding look, or abſence of mind; and theſe are the infallible indications of contempt for the company, the very worſt ingredient in the paſſion of pride. If this contempt be often excited, it will be formed into a habit; and the proud man will be ſo much under its influence, as to inſult his inferiors, and ſometimes his equals, without forming the reſolution to inſult either the one or the other. Such a character is hateful to every company, and is ſo far from indicating true dignity of mind in him to whom it belongs, that it is obviouſly aſſociated with meanneſs, and indicates a conſciouſneſs of ſome radical defect. He who poſſeſſes real and conſpicuous merit has no occaſion to depreſs others for the purpoſe of raiſing himſelf; his ſuperiority will be cheerfully acknowledged: but when a man of undoubted eminence in one reſpect, is ſo ſwollen with pride as to make him wiſh to appear great in all reſpects, he has no other means of enforcing his ill-founded claim, than diſplaying his acknowledged ſuperiority, with ſuch inſolence as may drive at a diſtance from him every perſon by whom he is conſcious that in many inſtances he might be more than rivalled. Whoever is proud of knowledge, would do well to conſider how much knowledge he wants.

The ſame obſervations which we have made on pride of parts will apply to every other ſpecies of pride, ſuch as pride of birth, office, or riches, &c. The peace and order of ſociety require difference of rank, accompanied with different degrees of authority; and he who inherits a title or office from his anceſtors, may without pride be conſcious of his ſuperiority, provided he forget not that ſuch ſuperiority is conferred on families and individuals, not for their own ſakes, but for the good of the community. The peer, who keeps this circumſtance in mind, may maintain his ſtation, and repreſs the forward petulence of the plebeian, without giving offence to any thinking man; but if he dwell upon his rank with too much complacency, he will in proceſs of time be apt to conſider himſelf and his family as ſuperior by nature to thoſe upon whom no title has been conferred, and then his pride will become intolerable. If we could trace our deſcent, ſays Seneca, we ſhould find all ſlaves to come from princes, and all princes from ſlaves. To be proud of knowledge, is to be blind in the light; to be proud of virtue, is to poiſon ourſelves with the antidote; to be proud of authority, is to make our riſe our downfall. The beſt way to humble a proud man is to neglect him.

PRIDEAUX (Humphry) was born at Padſtow in Cornwall in 1648, and was honourably deſcended by both parents. Three years he ſtudied at Weſtminſter under Dr Buſby; and then was removed to Chriſt-church, Oxford. Here he publiſhed, in 1676, his *Marmora Oxonienſia ex Arundelianis, Seldenianis, aliiſque conflata, cum perpetuo Commentario.* This introduced him to the lord chancellor Finch, afterwards earl of Nottingham, who in 1679 preſented him to the rectory of St Clements near Oxford, and in 1681 beſtowed on him a prebend of Norwich. Some years after he was engaged in a controverſy with the Papiſts at Norwich, concerning the validity of the orders of the church of England, which produced his book upon that ſubject. In 1688 he was inſtalled in the archdeaconry of Suffolk; to which he was collated by Dr Lloyd, then biſhop of Norwich. In 1691, upon the death of Dr Edward Pococke, the Hebrew profeſſorſhip at Oxford being vacant, was offered to Dr Prideaux, but he refuſed it. In 1697, he publiſhed his Life of Mahomet, and in 1702 was inſtalled dean of Norwich. In 1710 he was cut for the ſtone, which interrupted his ſtudies for more than a year. Some time after his return to London, he proceeded with his Connection of the Hiſtory of the Old and New Teſtament; which he had begun when he laid aſide the deſign of writing the Hiſtory of Appropriations. He died in 1724.

Chandler's Travels in Aſia Minor.

PRIENE, an ancient town of Aſia Minor. It is now called *Samſun*, and *Samſun-kateſi*, which do not however appear to be very recent. It was taken in 1391 by Bajazet, who ſubdued Ionia. It had formerly, without including the citadel, three gateways; one of which was towards Kelibeſh, an adjoining village; and without it are vaults of ſepulchres. The entrance was not wide. A part of the arch, conſiſting of a ſingle row of maſſive ſtones, ſtill remains; but thoſe on which it reſts are ſo corroded by age, broken, or diſtorted, as to ſeem every moment ready to yield and let down their load. A rugged way leads to a ſecond opening in the wall oppoſite to this, and about a mile from it; beyond which are likewiſe vaults of ſepulchres. Between theſe was a gate facing to the plain; and on the left hand going out of it is a hole, reſembling the mouth of an oven, in the ſide of a ſquare tower; and over it an inſcription in ſmall characters, exceedingly difficult to be read. It ſignifies, that a certain Cyprian in his ſleep had beheld Ceres and Proſerpine arrayed in white; and that in three viſions they had enjoined the worſhip of a hero, the guardian of the city, and pointed out the place where, in obedience to them, he had erected the god. This was probably ſome local hero, whoſe little image was ſet in the wall, and whoſe name and memory have periſhed.

PRIEST, a perſon ſet apart for the performance of ſacrifice, and other offices and ceremonies of religion. Before the promulgation of the law of Moſes, the firſt born of every family, the fathers, the princes, and the kings, were prieſts. Thus Cain and Abel, Noah, Abraham, Melchizedec, Job, Iſaac, and Jacob, offered themſelves their own ſacrifices. Among the Iſraelites, after their exod from Egypt, the prieſthood was confined to one tribe, and it conſiſted of three orders, the *high*-prieſt, *prieſts*, and *Levites*. The prieſthood was made hereditary in the family of Aaron, and the firſt-born of the oldeſt branch of that family, if he had no legal blemiſh, was always the high-prieſt. This divine appointment was obſerved with conſiderable accuracy till the Jews fell under the dominion of the Romans, and had their faith corrupted by a falſe philoſophy.—Then, indeed, the high-prieſthood was ſometimes ſet up to ſale, and inſtead of continuing for life, as it ought to have done, it ſeems from ſome paſſages in the New Teſtament, to have been nothing more than an annual office. There is ſufficient reaſon, however, to believe, that it was never diſpoſed of but to ſome deſcendant of Aaron, capable of filling it, had the older branches been extinct. (For the conſecration and offices of the Jewiſh prieſthood, we refer our readers to the books of Moſes). In the time of David, the inferior prieſts were divided into 24 companies, who were to ſerve in rotation, each company by itſelf, for a week. The order in which the ſeveral courſes were to ſerve was determined by lot; and each courſe was in all ſucceeding ages called by the name of its original chief.—All nations have had their *prieſts*. The Pagans had *prieſts* of Jupiter, Mars, Bacchus, Hercules, Oſiris, and Iſis, &c.; and ſome deities had *prieſteſſes*. The Mahometans have prieſts of different orders, called *ſchiek* and *mufti*; and the Indians and Chineſe have their *bramins* and *bonzes*.

It has been much diſputed, whether, in the Chriſtian church, there be any ſuch officer as a *prieſt*, in the proper ſenſe of the word. The church of Rome, which holds the *propitiatory* ſacrifice of the *maſs*, has of courſe her proper *prieſthood*. In the church of England, the word *prieſt* is retained to denote the ſecond order in her hierarchy, but we believe with very different ſignifications, according to the different opinions entertained of the

Lord's ſupper. Some few of her divines, of great learning, and of undoubted Proteſtantiſm, maintain that the Lord's ſupper is a *commemorative* and *euchariſtical ſacrifice*. Theſe conſider all who are authoriſed to adminiſter that ſacrament as in the ſtricteſt ſenſe *prieſts*. Others hold the Lord's ſupper to be a *feaſt* upon the *one* ſacrifice, once offered on the croſs; and theſe too muſt conſider themſelves as clothed with ſome kind of prieſthood. Great numbers, however, of the Engliſh clergy, perhaps the majority, agree with the church of Scotland, in maintaining that the Lord's ſupper is a rite of no other moral import, than the mere commemoration of the death of Chriſt. Theſe cannot conſider themſelves as *prieſts* in the rigid ſenſe of the word, but only as *preſbyters*, of which the word *prieſt* is a contraction of the ſame import with *elder*. See Supper *of the Lord*.

PRIMÆ viæ, among phyſicians, denote the whole alimentary duct; including the œſophagus, ſtomach, and inteſtines, with their appendages.

PRIMAGE, in commerce, a ſmall duty at the water-ſide, uſually about 12d. *per* ton, or 6d. *per* bale, due to the maſter and mariners of a ſhip.

PRIMARY, firſt in dignity, chief, or principal.

Primary Qualities of Bodies. See Metaphysics, n° 152.

PRIMATE, in church-polity, an archbiſhop, who is inveſted with a juriſdiction over other biſhops.

PRIME, primus, an appellation given to whatever is firſt in order, degree, or dignity, among ſeveral things of the ſame or like kind; thus we ſay, the prime miniſter, prime coſt, &c.

Prime is ſometimes uſed to denote the ſame with decimal, or the tenth part of an unit.

Prime-Figure, in geometry, one which cannot be divided into any other figures more ſimple than itſelf, as a triangle among planes, and the pyramid among ſolids.

For prime numbers, in arithmetic, ſee the article Number.

Prime of the Moon, is the new moon when ſhe firſt appears, which is about three days after the change.

Prime Vertical, is that vertical circle which paſſes through the poles of the meridian, or the eaſt and weſt points of the horizon; whence dials projected on the plane of this circle are called *prime vertical*, or *north-and-ſouth dials*.

Prime, in the Romiſh church, is the firſt of the canonical hours, ſucceeding to lauds.

Prime, in fencing, is the firſt of the chief guards. See Guard.

PRIMER seisin, in feodal law, was a feodal burden, only incident to the king's tenants *in capite*, and not to thoſe who held of inferior or meſne lords. It was a right which the king had, when any of his tenants *in capite* died ſeized of a knight's fee, to receive of the heir (provided he were of full age) one whole year's profits of the lands if they were in immediate poſſeſſion, and half a year's profits if the lands were in reverſion expectant on an eſtate for life. This ſeems to be little more than an additional relief, (ſee Relief); but grounded upon this feodal reaſon, That, by the ancient law of feods, immediately upon the death of a vaſſal the ſuperior was entitled to enter and take ſeiſin or poſſeſſion of the land, by way of protection againſt intruders, till the heir appeared to claim it, and receive inveſtiture: and for the time the lord ſo held it, he was entitled to take the profits; and unleſs the heir claimed within a year and day, it was by the ſtrict law a forfeiture. This practice however ſeems not to have long obtained in England, if ever, with regard to tenures under inferior lords; but, as to the king's tenures *in capite*, this *prima ſeiſina* was expreſsly declared, under Hen. III. and Ed. II. to belong to the king by prerogative, in contradiſtinction to other lords. And the king was entitled to enter and receive the whole profits of the land, till livery was ſued; which ſuit being commonly within a year and day next after the death of the tenant, therefore the king uſed to take at an average the *firſt-fruits*, that is to ſay, one year's profits of the land. And this afterwards gave a handle to the popes, who claimed to be feodal lords of the church, to claim in like manner from every clergyman in England the firſt year's profits of his benefice, by way of *primitiæ*, or firſt-fruits.—All the charges ariſing by primer ſeiſin were taken away by 12 Car. II. c. 24.

PRIMING, in gunnery, the train of powder that is laid, from the opening of the vent, along the gutter or channel on the upper part of the breech of the gun: which, when fired, conveys the flame to the vent, by which it is further communicated to the charge, in order to fire the piece. This operation is only uſed on ſhipboard at the proof, and ſometimes in garriſon; for, on all other occaſions, tubes are uſed for that purpoſe.

Priming-Wire, in gunnery, a ſort of iron needle employed to penetrate the vent or touch-hole of a piece of ordnance, when it is loaded: in order to diſcover whether the powder contained therein is thoroughly dry and fit for immediate ſervice; as likewiſe to ſearch the vent and penetrate the cartridge, when the guns are not loaded with the looſe powder.

Priming, among painters, ſignifies the laying on of the firſt colour.

PRIMIPILUS, in antiquity, the centurion of the firſt cohort of a legion, who had the charge of the Roman eagle.

PRIMITIÆ, the firſt-fruits gathered of the earth, whereof the ancients made preſents to the gods.

PRIMITIVE, in grammar, is a root or original word in a language, in contradiſtinction to *derivative*; thus, *God* is a primitive; *godly*, a derivative; and *godlike*, a compound.

PRIMOGENITURE, the right of the firſt-born, has among moſt nations been very conſiderable. The firſt-born ſon in the patriarchal ages had a ſuperiority over his brethren, and, in the abſence of his father, was prieſt to the family. Among the Jews, he was conſecrated to the Lord, had a double portion of the inheritance, and ſucceeded in the government of the family or kingdom. It is, however, remarkable, and unqueſtionably ſhows the connection between this inſtitution and the birth and office of our Saviour, that if a woman's firſt child was a girl, neither ſhe, nor the children that came after her, were conſecrated.

In every nation of Europe, the right of primogeniture prevails in ſome degree at preſent, but it did not prevail always. The law which calls the elder-born to the crown, preferably to all others, was not introduced into France till very late; it was unknown to the firſt race of kings, and even to the ſecond. The four ſons of Clovis ſhared the kingdom equally among themſelves; and Louis le Debonnaire did the ſame: it was not till the race of Hugh Capet, that the prerogative of ſucceſſion to the crown was appropriated to the firſt-born.

By the ancient cuſtom of *Gavel-kind*, ſtill preſerved in ſome parts of Britain, primogeniture is of no account; the paternal eſtate being equally ſhared by all the ſons. And it has been a matter of violent and learned diſpute, whether, at the death of Alexander III. Baliol or Bruce was, by the law as it then ſtood, heir to the crown of Scotland. The former had undoubtedly the right of primogeniture, but the latter ſtood in one degree of nearer relation to the deceaſed ſovereign: and the Scottiſh barons, not being able to determine whoſe claim was beſt founded, referred the queſtion to Edward I. of England, and thereby involved their country in a long and ruinous war. See SCOTLAND.

PRIMORIE, is a name given by the Slavi to that tract of ſea-coaſt which lies between the two rivers Cettina and Narenta, the firſt of which is the Neſtus and Tiluras, and the ſecond the Narus, of the ancients; compriſing what was properly called Dalmatia two ages before our era, and which was known to the Greeks of the low times under the name of *Paratalaſſia*. Appian informs us, that the Ardei or Vardei poſſeſſed many cities there, part of which they ſeized before the invaſion of the Romans, and part they built themſelves. We learn alſo from the *Tabula Pentingeriana*, that after the conqueſt many of thoſe cities remained, and were inhabited by the conquerors, who alſo founded new ſettlements. And indeed were theſe proofs wanting, the numerous inſcriptions found near the ſea, and ſometimes among the hills, would render it at leaſt probable. The coaſt is extremely pleaſant, the ſoil fertile, and the ſituation moſt convenient for commerce with the inland provinces. By bad management, however, much ground has been loſt near the ſea, by its being covered with gravel, and by imprudent cultivation of the hills, the impetuous fury of the mountain torrents has rendered a part of it uninhabitable. Macarſka is now the only town in the territory, and it appears to have riſen out of the ruins of the ancient RATANEUM of Pliny. It formed a part of the Narentan ſtate for ſeveral ages, and afterwards, together with the reſt of Primorie, paſſed under the obedience of various Chriſtian princes. It afterwards became ſubject to the Ottoman Porte, and at laſt voluntarily ſubjected itſelf to the Venetian republic. See DALMATIA and MACARSKA. See alſo Fortis's *Travels into Dalmatia*, p. 265——318.

PRIMULA, the PRIMROSE: A genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 21ſt order, *Preciæ*. The involucrum lies under a ſimple umbel; the tube of the corolla cylindrical; with the mouth or limb patulous. This genus, including alſo the polyanthus and auricula, furniſhes an excellent collection of low, fibrous-rooted, herbaceous flowery perennials.

1. The primula veris, or ſpring primroſe, has thick and very fibrous roots, crowned by a cluſter of large oblong indented rough leaves, and numerous flower-ſtalks, from about three or four, to five or ſix inches high; each terminated commonly by one flower.—The varieties are, common yellow-flowered primroſe of the woods—white primroſe—paper-white—red—double red—double yellow, and double white.—All theſe flower abundantly in March and April, and continue for a month or ſix weeks.

The cowſlip primroſe, or cowſlip, has very thick fibrous roots, crowned by a cluſter of oblong, indented round leaves, and upright, firm, flower-ſtalks five or ſix inches high, terminated each by a cluſter of ſmall flowers. The varieties are, Common ſingle yellow cowſlip of the meadows—double yellow cowſlip—ſcarlet cowſlip—hoſe-and-hoſe cowſlip; one flower growing out of the boſom of another, the lowermoſt ſerving as a calyx; all of which varieties have the flower-ſtalks crowned by many flowers in branches.—They flower in April and May, continuing in ſucceſſion a month or ſix weeks.

2. The polyanthus, has thick fibrous roots, increaſing into large bunches, crowned with a cluſter of large oblong indented rough leaves; amidſt them upright flower-ſtalks ſix or eight inches high, terminated moſtly by a cluſter of ſeveral ſpreading flowers of many different colours in the varieties. The principal are, purple, red, gold, orange-coloured, &c. They all flower beautifully in April and May, and frequently again in autumn; and ſometimes even in winter, if the ſeaſon is mild. The polyanthus is one of the noted prize-flowers among the floriſts; many of whom are remarkably induſtrious in raiſing a conſiderable variety of different ſorts, as well as in uſing every art to blow them with all requiſite perfection; for, among the virtuoſi, a polyanthus muſt poſſeſs ſeveral peculiar properties in order to be admitted in their collections. The chief properties required in a floriſt's polyanthus are, 1. The ſtem or flower-ſtalk ſhall be upright, moderately tall, with ſtrength in proportion, and crowned by a good regular branch of flowers on ſhort pedicles, ſtrong enough to ſupport them nearly in an upright poſition. 2. The florets of each branch ſhould be equally large, ſpreading open flat, with the colours exquiſite, and the ſtripes and variegations lively and regular. 3. The eye in the centre of each floret ſhould be large, regular, and bright; and the antheræ, by the floriſts called the *thrum*, ſhould riſe high enough to cover the mouth of the tube or hollow part in the middle of the florets, and render them what they call *thrum-eyed*; but when the ſtyle elevates the ſtigma above the antheræ, the eye of the tube generally appears hollow, ſhowing the ſtigma in the middle, like the head of a pin, and is rejected as an incomplete flower, though its other properties ſhould be ever ſo perfect. This pin-eyed polyanthus, however, though rejected by the floriſts, is the flower in its moſt perfect ſtate, and great numbers of them are of as beautiful forms and colours as the thrum-eyed varieties.

3. The auricula has a thick fibrous root, crowned by a cluſter of oblong, fleſhy, broad, ſerrated, ſmooth leaves, reſembling the ſhape of a bear's ear; and amidſt them upright flower-ſtalks from about three or four to ſix or eight inches high, terminated by an umbellate cluſter of beautiful flowers, of many different

colours in the varieties. All of theſe have a circular eye in the middle of each flower, and of which there are different colours; whence the auriculas are diſtinguiſhed into yellow-eyed, white-eyed, &c. The petals of moſt of the kinds are powdered with an exceeding fine farina or mealy powder, which contributes greatly to the beauty of the flower. They all flower in April or May, continuing a month or ſix weeks in beauty, and ripening plenty of ſeeds in June.

Culture. All the varieties of the common ſpring primroſe multiply ſo faſt by the roots, that it is ſcarce worth while to raiſe them from ſeeds. However, though many ſingle kinds may be raiſed from ſeed, yet parting the roots is the only method by which the double kind can be preſerved; and the ſame thing is to be obſerved of all the reſt.

PRIMUM MOBILE, in the Ptolemaic aſtronomy, the ninth or higheſt ſphere of the heavens, whoſe centre is that of the world, and in compariſon of which the earth is but a point. This they will have to contain all other ſpheres within it, and to give motion to them, turning itſelf, and all them, quite round in 24 hours.

PRINCE, PRINCEPS, in polity, a perſon inveſted with the ſupreme command of a ſtate, independent of any ſuperior.

PRINCE alſo denotes a perſon who is a ſovereign in his own territories, yet holds of ſome other as his ſuperior; ſuch are the princes of Germany, who, though abſolute in their reſpective principalities, are bound to the emperor in certain ſervices.

PRINCE alſo denotes the iſſue of princes, or thoſe of the royal family. In France, before the revolution, they were called *princes of the blood*, and during the ſhort continuance of the conſtitution of 1791, *French princes*. In England the king's children are called *ſons and daughters of England*; the eldeſt ſon is created prince of Wales; the cadets are created dukes or earls as the king pleaſes; and the title of all the children is *royal highneſs*; all ſubjects are to kneel when admitted to kiſs their hand, and at table out of the king's preſence they are ſerved on the knee. See *ROYAL Family*

PRINCE of the Senate, in old Rome, the perſon who was called over firſt in the roll of ſenators, whenever it was renewed by the cenſors: he was always of conſular and cenſorian dignity. See the article SENATE.

PRINCE's Metal, a mixture of copper and zinc, in imitation of gold. See CHEMISTRY, n° 1154.

PRINCETOWN. See *New Jerſey*.

Edin. Phil. Tranſ. v. iii. p. 13. &c.

PRINCE of Wales's Iſland, or *Polu Penany*, is ſituated in the entrance of the ſtraits of Malacca, in 100 degrees of eaſt longitude, and in five degrees of north latitude. It is about ſeven leagues in length and three in breadth. Its northern extremity runs nearly parallel with the main land at a diſtance of about two miles, by which a fine channel is formed, where the greateſt fleets might ride in perfect ſafety, the height of the ſurrounding mountains acting as a barrier againſt the force of the prevailing winds. The climate, conſidering its vicinity to the equator, is remarkably mild. Eighty degrees is about the mean height of the thermometer at noon, which, during the night, is ſeldom above 70. Its healthfulneſs is certainly not ſurpaſſed by that of any European ſettlement on the coaſt. Out of a garriſon of 300 troops (natives of Hindoſtan), not one died for the ſpace of 14 months; a ſingular fact to be experienced by a new ſettlement in an uncleared country. This great ſalubrity is perhaps the effect of a conſtant ventilation, ſupported by almoſt continued but gentle breezes, added to the dryneſs of the ſoil, the uniform but gradual elevation from the ſea to the foot of the hills preventing thoſe ſtagnations of water which, in tropical latitudes, are ſo highly prejudicial to the health of man.

A ridge of beautiful mountains, deeply indented with valleys, and covered with evergreens, divides the iſland longitudinally. Innumerable rivulets receive their origin from theſe mountains, and are remarkable for the tranſparency and coolneſs of their waters. The ſoil, which is light and ſandy near the ſea, gradually changes to a rich clay as it approaches to the high lands. There the ſugar-cane grows with the utmoſt luxuriance, and the moſt plentiful crops of rice are everywhere produced. The gardens have already furniſhed the inhabitants with cabbages and potatoes; and when induſtry ſhall have reached the tops of the mountains, it will be no ſurpriſe to ſee in the plantations moſt of the productions of Europe in their utmoſt perfection. In decorating the landſcapes of this little iſland, nature has been peculiarly laviſh. An aſſemblage of flowering trees and ſhrubs in perpetual bloſſom, and endleſs in the variety of their ſpecies, form the firſt ſhade. Theſe are overtopped by foreſt trees of an immenſe height, which ſpread their vaſt branches on every ſide, and are covered with the richeſt foliage. Here ſtrangers feel with rapture the effect of the breezes, which, from whatſoever quarter they blow, are ſtrongly impregnated with the fragrance of the groves.

The original animal productions of this iſland are very limited. Of quadrupeds, the wild hog, deer, and ſquirrel, nearly comprehend the whole: but the abſence of the tiger and leopard, whoſe numbers and ferocity almoſt render the oppoſite ſhores uninhabitable, amply compenſates for this deficiency. The flying fox and ſquirrel are natives of this iſland; the former a nondeſcript, and a great natural curioſity. Of birds there are alſo but few, and only one which is remarkable for the melody of its notes. The crow and ſparrow, the never-failing attendents on population, have but lately made their appearance. They are now, however, rapidly increaſing and multiplying. All the domeſtic animals arrive here at great perfection.

The ſea which ſurrounds the iſland, affords a vaſt variety of fiſh of the moſt delicious flavour, and its ſhores abundance of the fineſt turtle and oyſters. In no ſituation indeed are the conveniencies and luxuries of life enjoyed in greater profuſion. The advantages of the iſland in a political and commercial view, are too obvious to require to be pointed out.

PRINCE William's Sound, ſituated on the north weſt coaſt of America, and ſo named by Captain Cook in 1778. The men, women, and children of this ſound are all clothed in the ſame manner. Their ordinary dreſs is a ſort of cloſe frock, or rather robe, which ſometimes reaches only to the knees, but generally down to the ancles. Theſe frocks are compoſed of the ſkins of various animals, and are commonly worn with the hairy ſide outwards. The men often paint their faces of a black colour, and of a bright red, and ſometimes of a bluiſh or leaden hue; but not in any regular figure. The women puncture or ſtain the chin with black, that comes to a point in each of their cheeks. Their canoes are of two ſorts; the one large and open, the other ſmall and covered. The framing conſiſts of ſlender pieces of wood, and the outſide is compoſed of the ſkins of ſeals, or other ſea animals, ſtretched over the wood. Their weapons, and implements for hunting and fiſhing, are the ſame as thoſe uſed by the Greenlanders and Eſquimaux. Many of their ſpears are headed with iron, and their arrows are generally pointed with bone. The food they were ſeen to eat was the fleſh of ſome animal, either roaſted or broiled, and dried fiſh. Some of the former that was purchaſed had the appearance of bear's fleſh. They alſo eat a larger ſort of fern-root, either baked or dreſſed in ſome other method. Their drink, in all probability, is water; for, in their canoes, they brought ſnow in wooden veſſels, which they ſwallowed by mouthfuls. Our knowledge of the animals of this part of the American continent is entirely derived from the ſkins that were brought by the natives for ſale. Theſe were principally of bears, common and pine martins, ſea-otters, ſeals, racoons, ſmall ermines, foxes, and the whitiſh cat or lynx. The birds found here were the halcyon, or great king's-fiſher, which had fine bright colours; the white-headed eagle, and the humming-bird. The fiſh that were principally brought to market for ſale were torſk and halibut. The rocks were almoſt deſtitute of ſhell-fiſh; and the only other animal of this tribe that was obſerved was a reddiſh crab, covered with very large ſpines. Few vegetables of any kind were obſerved; and the trees that chiefly grew about this ſound were the Canadian ſpruce pine, ſome of which were of a conſiderable ſize. E. Long. 115. 21. N. Lat. 59. 33.

PRINCIPAL, the chief and moſt neceſſary part of a thing. The principal of a college or hall is the maſter thereof.

In commerce, principal is the capital of a ſum due or lent; ſo called in oppoſition to intereſt. See INTEREST.

It alſo denotes the firſt fund put by partners into a common ſtock, by which it is diſtinguiſhed from the calls or acceſſions afterwards required.

PRINCIPAL, in muſic. See FUNDAMENTAL, in muſic, and GENERATOR, in muſic.

Blackſt. Comment. b. iv. c. 3.

PRINCIPAL, in law, is either the actor or abſolute perpetrator of the crime, who is called a *principal*, in the firſt degree; or he who is preſent, aiding and abetting the fact to be done, who is denominated a *principal* in the ſecond degree. The preſence of a principal need not always be an actual immediate ſtanding by, within ſight or hearing of the fact; but there may be alſo a conſtructive preſence, as when one commits a robbery or murder, and another keeps watch or guard at ſome convenient diſtance. And this rule has alſo other exceptions; for in caſe of murder by poiſoning, a man may be a principal felon by preparing and laying the poiſon, or giving it to another (who is ignorant of its poiſonous quality) for that purpoſe; and yet not adminiſter it himſelf, nor be preſent when the very deed of poiſoning is committed. And the ſame reaſoning will hold, with regard to other murders committed in the abſence of the murderer, by means which he had prepared before-hand, and which probably could not fail of their miſchievous effect. As by laying a trap or pit-fall for another, whereby he is killed; letting out a wild beaſt, with an intent to do miſchief; or exciting a madman to commit murder, ſo that death thereupon enſues: in every one of theſe caſes the party offending is guilty of murder as a principal, in the firſt degree. For he cannot be called an acceſſory, that neceſſarily pre-ſuppoſing a principal; and the poiſon, the pit-fall, the beaſt, or the madman, cannot be held principals, being only the inſtruments of death. As therefore he muſt be certainly guilty, either as principal or acceſſory, and cannot be ſo as acceſſory, it follows that he muſt be guilty as principal; and if principal, then in the firſt degree; for there is no other criminal, much leſs a ſuperior in the guilt, whom he could aid, abet, or aſſiſt.

PRINCIPAL *Point*, in perſpective, is a point in the perſpective plane, upon which a line drawn from the eye, perpendicular to the plane falls.

This point is in the interſection of the horizontal and vertical plane; and is alſo called the *point of ſight*, and *point of the eye*. See PERSPECTIVE.

PRINCIPAL *Ray*, in perſpective, is that which paſſes perpendicularly from the ſpectator's eye to the perſpective plane, or picture.

Whence the point where this ray falls on the plane, is by ſome alſo called the *principal point*, which other writers call *the centre of the picture*, and *the point of concurrence*.

PRINCIPATO, the name of a province of Italy, in the kingdom of Naples, which is divided into two parts, called by the Italians the *Principato Ultra* and the *Principato Citra*, that is, the Hither and Farther Principato. The Hither Principato is bounded on the north by the Farther Principato and part of the Terra-di-Lavoro, on the weſt and ſouth by the Tuſcan Sea, and on the eaſt by the Baſilicata. It is about 60 miles in length, and 30 in breadth; the ſoil is fertile in wine, corn, oil, and ſaffron; and they have a great deal of ſilk, beſides ſeveral mineral ſprings. The capital town is Salerno. The Farther Principato is bounded on the north by the county of Moleſe and the Terra-di-Lavoro, on the weſt by the Tuſcan Sea, on the ſouth by the Hither Principato, and on the eaſt by the Capitanata. It is about 37 miles in length, and 30 in breadth. The Appennine mountains render the air cold; and the ſoil is not very fertile either in corn or wine, but it produces cheſnuts, and paſtures in great plenty. Benevento is the capital town.

PRINCIPLE, PRINCIPIUM, in general, is uſed for the cauſe, ſource, or origin of any thing.

PRINCIPLE, in human nature. See DISPOSITION.

PRINCIPLE in ſcience, is a truth, admitted without proof, from which other truths are inferred by a chain of reaſoning. Principles are of two kinds, *primary* and *general;* and to the laſt the name of *axioms* is uſually given on account of their importance and *dignity*. An axiom or *general* principle, when the terms in which it is expreſſed are underſtood, muſt be a ſelf-evident truth; but from its very nature it cannot be a *firſt* truth. Our firſt truths are all *particular*. A child knows that two *particular* lines, each an inch long, are equal to one another, before he has formed any *general* notions of length and equality. "Things equal to one and the ſame thing are equal to one another," is the firſt of Euclid's axioms; and an axiom it undoubtedly is, but to no man has it been a *firſt* truth. It is, if we may uſe the expreſſion, a *genus* or *claſs* of truths comprehending under it numberleſs individuals. Were a full-grown man introduced into the world, without a ſingle idea in his mind, as we may ſuppoſe Adam to have been, he would inſtantly perceive, upon laying together three pieces of wood each a foot long, that they were all equal in length; and if he were to cut another to the ſame length with *any one* of them, he would find upon trial, that it was of the ſame length with them all. After a few ſimple experiments of this kind, he would, by a law of human thought, infer that all things equal in length or in any other dimenſion, to any *one* thing, are in that dimenſion equal to one another.

It was not therefore with ſuch weakneſs as ſome have imagined, that Hobbes affirmed thoſe propoſitions commonly called axioms, not to be primary but ſecondary principles. A primary principle deſerves not the name of an axiom, as it is only a particular truth including in it no other truth. There is not one of Euclid's axioms which has not been the reſult of induction, though we remember not the time at which the induction was made. That the whole is greater than any of its parts is a general truth which no man of common ſenſe can controvert; but every one diſcovered that truth by obſerving that his body was larger than his head, his foot, or his hand; that a mountain is larger than a mole-hill in the middle of it; and that a piece of timber meaſuring what is called a yard is longer than any one of the diviſions marked upon it, and termed inches. The particular obſervations are made through the ſenſes and treaſured up in the memory; and the intellect, by its conſtitution, compares them together, marks in what they agree and diſagree, and thence draws its *axioms* or *general* principles. He, therefore, who ſhould admit the truth of an axiom, and deny the evidence of ſenſe and perception, would act as abſurdly as he who accepts payment in a bank-bill, and refuſes it in the individual pieces of gold or ſilver which that bill repreſents. General axioms are of infinite uſe in the purſuits of ſcience; but it is not becauſe they create new truths; they only ſhorten the proceſs in the diſcovery of ſuch as might be found, with labour, through the medium of particular propoſitions. See *Campbell's Philoſophy of Rhetoric* and *Tatham's Chart and Scale of Truth*.

PRINCIPLES, in Phyſics, are often confounded with elements, or the firſt and ſimpleſt parts whereof natural bodies are compounded, and into which they are again reſolvable by the force of fire.

PRINGLE (Sir John), an eminent phyſician and philoſopher, was a younger ſon of Sir John Pringle of Stitchel, in the ſhire of Roxburgh, Baronet; took the degree of M. D. at Leyden, 1730; and publiſhed there *Diſſertatio Inauguralis de Marcore Senili*, 4to. After having been ſome years profeſſor of moral philoſophy at Edinburgh, he was in June 1745 appointed phyſician to the duke of Cumberland, and phyſician-general to the hoſpital of the forces in Flanders, where the earl of Stair appears to have been his patron. In February 1746, Dr Pringle, Dr Armſtrong, and Dr Barker, were nominated phyſicians to the hoſpital for lame, maimed, and ſick ſoldiers, behind Buckingham-houſe; and in April 1749, Dr Pringle was appointed phyſician in ordinary to the king. In 1750 he publiſhed "Obſervations on the Nature and Cure of Hoſpital and Gaol Fevers, in a Letter to Dr Mead," 8vo (reprinted in 1755); and in 1752 he favoured the public with the reſult of his long experience in an admirable treatiſe under the title of "Obſervations on the Diſorders of the Army in Camp and Garriſon," 8vo. On the 14th of April 1752, he married Charlotte, ſecond daughter of Dr Oliver, an eminent phyſician at Bath. In 1756 he was appointed jointly with Dr Wintringham (now Sir Clifton Wintringham, Bart.) phyſician to the hoſpital for the ſervice of the forces of Great Britain. After the acceſſion of his preſent majeſty, Dr Pringle was appointed phyſician to the queen's houſehold, 1761; phyſician in ordinary to the queen in 1763, in which year he was admitted of the college of phyſicians in London; and on the 5th of June 1766, he was advanced to the dignity of a baronet of Great Britain. In 1772 he was elected preſident of the Royal Society, where his ſpeeches for five ſucceſſive years, on delivering the prize-medal of Sir Godfrey Copley, gave the greateſt ſatisfaction. Sir John Pringle in 1777 was appointed phyſician-extraordinary to the king. He was alſo a fellow of the College of Phyſicians at Edinburgh, and of the Royal Medical Society at Paris; member of the Royal Academies at Paris, Stockholm, Gottingen, and of the Philoſophical Societies at Edinburgh and Haerlem; and continued preſident of the Royal Society till November 1778; after which period he gradually withdrew from the world, and in 1781 quitted his elegant houſe in Pall Mall (where he had long diſtinguiſhed himſelf as the warm friend and patron of literary men of every nation and profeſſion), and made an excurſion to his native country. He returned to London in the latter end of that year; died greatly beloved and reſpected January 18. 1782; and having no children, was ſucceeded in eſtate, and alſo (agreeably to the limitation of the patent) in title, by his nephew, now Sir James Pringle, Bart. Among this worthy phyſician's communications to the Royal Society, the following are the principal: 1. "Some Experiments on Subſtances reſiſting Putrefaction," Phil. Tranſ. N° 495, p. 580; and N° 496, p. 525, 550; reprinted, with additions, in Martin's Abridgment, vol. xi. p. 1365. 2. "Account of ſome Perſons ſeized with the Gaol Fever by working in Newgate, and of the manner by which the Infection was communicated to one entire Family," vol. xlviii. p. 42. At the requeſt of Dr Hales, a copy of this uſeful paper was inſerted in the Gentleman's Magazine, 1753, p. 71, before its appearance in the Tranſactions. 3. "A remarkable Caſe of Fragility, Flexibility, and Diſſolution of the Bones." ib. p. 297. 4. "Account of the Earthquakes felt at Bruſſels," vol. xlix. p. 546. 5. "Account of ſinking of a River near Pontypool, in Monmouthſhire," ib. p. 547. 6. "Account of an Earthquake felt Feb. 18. 1756, along the coaſt of England, between Margate and Dover," ib. p, 579. 7. "Account of the Earthquake felt at Glaſgow and Dumbarton; alſo of a Shower of Duſt falling on a Ship between Shetland and Iceland," ib. p. 509. 8. "Several Accounts of the Fiery Meteor which appeared on Sunday, November 26. 1758, between eight and nine at night," vol. l. p. 218. 9. "Account of the Virtues of Soap in diſſolving the Stone, in the Caſe of the Reverend Mr Matthew Simpſon," ib. p. 221. 10. "Account of the Effects of Electricity in Paralytic Caſes," ib. p. 481. And ſee a letter to him on that ſubject from Profeſſor Winthorp. "Some Account of the Succeſs of the *Vitrum Ceratum Antimonii*," was printed in the Edinburgh Medical Eſſays, vol. v.

PRINOS, in botany: A genus of the monogynia order, belonging to the hexandria claſs of plants; and in the natural method ranking under the 43d order, *Dumoſæ*. The calyx is ſexfid; the corolla monopetalous, and rotaceous; the belly hexaſpermous.

PRINTER, a perſon who compoſes and takes impreſſions from moveable characters ranged in order, by means of ink, and a preſs.

PRINTING, the art of taking impreſſions from characters or figures, moveable and immoveable, on paper, linen, ſilk, &c. There are three kinds of printing: the one from moveable letters, for books; another from copper-plates, for pictures; and the laſt from blocks, in which the repreſentation of birds, flowers, &c. are cut, for printing calicoes, linen, &c. The firſt is called *common* or *letter-preſs* printing; the ſecond, *rolling-preſs* printing; and the laſt, *calico*, &c. printing. The principal difference between the three conſiſts in this, that the firſt is caſt in relievo, in diſtinct pieces; the ſecond engraven in creux; and the third cut in relievo, and generally ſtamped, by placing the block upon the materials to be printed, and ſtriking upon the back of it.

1 Letter-preſs printing.

Of the above branches, LETTER-PRESS PRINTING is the moſt curious, and deſerves the moſt particular notice: for to it are owing chiefly our deliverance from ignorance and error, the progreſs of learning, the revival of the ſciences, and numberleſs improvements in arts, which, without this noble invention, would have been either loſt to mankind, or confined to the knowledge of a few. 2 Utility of this art. "To the art of printing (ſays an elegant eſſayeſt*), it is acknowledged we owe the reformation. It has been juſtly remarked, that if the books of Luther had been multiplied only by the ſlow proceſs of the hand-writing, they muſt have been few, and would have been eaſily ſuppreſſed by the combination of wealth and power: but, poured forth in abundance from the preſs, they ſpread over the land with the rapidity of an inundation, which acquires additional force from the efforts uſed to obſtruct its progreſs. He who undertook to prevent the diſperſion of the books once iſſued from the preſs, attempted a taſk no leſs arduous than the deſtruction of the hydra. Reſiſtance was vain, and religion was reformed: and we who are chiefly intereſted in this happy revolution muſt remember, amidſt the praiſes beſtowed on Luther, that his endeavours had been ineffectual, unaſſiſted by the invention of Fauſtus.

3 Good and evil reſulting from it.

"How greatly the cauſe of religion has been promoted by the art, muſt appear, when it is conſidered, that it has placed thoſe ſacred books in the hand of every individual, which, beſides that they were once locked up in a dead language, could not be procured without great difficulty. The numerous comments on them of every kind, which tend to promote piety, and to form the Chriſtian philoſopher, would probably never have been compoſed, and certainly would not have extended their beneficial influence, if typography had ſtill been unknown. By that art, the light, which is to illuminate a dark world, has been placed in a ſituation more advantageous to the emiſſion of its rays: but if it has been the means of illuſtrating the doctrines, and enforcing the practice of religion, it has alſo, particularly in the preſent age, ſtruck at the root of piety and moral virtue, by propagating opinions favourable to the ſceptic and the voluptuary. It has enabled modern authors, wantonly to gratify their avarice, their vanity, and their miſanthropy, in diſſeminating novel ſyſtems ſubverſive of the dignity and happineſs of human nature: but though the perverſion of the art is lamentably remarkable in thoſe volumes which iſſue, with offenſive profuſion, from the vain, the wicked, and the hungry, yet this good reſults from the evil, that as truth is great and will prevail, ſhe muſt derive freſh luſtre, by diſplaying the ſuperiority of her ſtrength in the conflict with ſophiſtry.

"Thus the art of printing, in whatever light it is viewed, has deſerved reſpect and attention. From the ingenuity of the contrivance, it has ever excited mechanical curioſity; from its intimate connection with learning, it has juſtly claimed hiſtorical notice; and from its extenſive influence on morality, politics, and religion, it is now become a ſubject of very important ſpeculation.

4 Its good effects overbalance the bad.

"But however we may felicitate mankind on the invention, there are perhaps thoſe who wiſh, that, together with its compatriot art of manufacturing gunpowder, it had not yet been brought to light. Of its effects on literature, they aſſert, that it has increaſed the number of books, till they diſtract rather than improve the mind; and of its malignant influence on morals, they complain, that it has often introduced a falſe refinement, incompatible with the ſimplicity of primitive piety and genuine virtue. With reſpect to its literary ill conſequences, it may be ſaid, that though it produces to the world an infinite number of worthleſs publications, yet true wit and fine compoſition will ſtill retain their value, and it will be an eaſy taſk for critical diſcernment to ſelect theſe from the ſurrounding maſs of abſurdity: and though, with reſpect to its moral effects, a regard to truth extorts the confeſſion, that it has diffuſed immorality and irreligion, divulged with cruel impertinence the ſecrets of private life, and ſpread the tale of ſcandal through an empire; yet theſe are evils which will either ſhrink away unobſerved in the triumphs of time and truth over falſehood, or which may, at any time, be ſuppreſſed by legiſlative interpoſition."

5 Hiſtory of the invention of printing.

Some writers have aſcribed the origin of this art to the Eaſt, and affixed a very early period to its invention; particularly P. Jovius, (*Hiſt.* lib. xiv. p. 226. ed. Florent. 1550), from whom Oſorius and many others have embraced the ſame opinion. But theſe have evidently confounded the European mode of printing with the *engraved tablets* which to this day are uſed in China. The invention of theſe tablets has been aſcribed by many writers even to an earlier period than the commencement of the Chriſtian era; but is with more probability aſſigned, by the very accurate Phil. Couplet, to the year 930. The *Hiſtoria Sinenſis* of Abdalla, written in Perſic in 1317, ſpeaks of it as an art in very common uſe. MEERMAN, vol. i. p. 16. 218, 219, vol. ii. p. 186. N. Trigault aſſerts that the Chineſe practiſed the art of printing five centuries before. Count Ferre Rezzonico found at Lyons plates with words and names engraven by a Nuremberger 1380.

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* Dr Knox.

The honour of having given riſe to the European method has been claimed by the cities of *Harlem*, *Mentz*, and *Straſburg*. And to each of theſe it may be aſcribed in a qualified ſenſe, as they made improvements upon one another.

6
Claim of Harlem.

I. The firſt teſtimony of the inventor is that recorded by Hadrian Junius, in his *Batavia*, p. 253, ed. Lugd. Bat. 1588; which, though it hath been rejected by many, is of undoubted authority. Junius had the relation from two reputable men; Nicolaus Galius (A), who was his ſchoolmaſter; and Quirinius Taleſius, his intimate and correſpondent. He aſcribes it to Laurentius, the ſon of John (Ædituus, or Cuſtos, of the cathedral at HARLEM, at that time a reſpectable office), upon the teſtimony of Cornelius, ſome time a ſervant to Laurentius, and afterwards bookbinder to the cathedral, an office which had before been performed by Franciſcan friars. His narrative was thus: "That, walking in a wood near the city (as the citizens of opulence uſe to do), he began at firſt to cut ſome letters upon the rind of a beech-tree; which for fancy's ſake, being impreſſed on paper, he printed one or two lines, as a ſpecimen for his grand-children (the ſons of his daughter) to follow. This having happily ſucceeded, he meditated greater things (as he was a man of ingenuity and judgment); and firſt of all, with his ſon-in-law Thomas Peter (who, by the way, left three ſons, who all attained the conſular dignity), invented a more glutinous writing-ink, becauſe he found the common ink ſunk and ſpread; and then formed whole pages of wood, with letters cut upon them; of which ſort I have ſeen ſome eſſays, in an anonymous work, printed only on one ſide, intitled, *Speculum noſtræ ſalutis*; in which it is remarkable, that in the infancy of printing (as nothing is complete at its firſt invention) the back ſides of the pages were paſted together, that they might not by their nakedneſs betray their deformity. Theſe beechen letters he afterwards changed for leaden ones, and theſe again for a mixture of tin and lead [*ſtanneas*] as a leſs flexible and more ſolid and durable ſubſtance. Of the remains of which types, when they were turned to waſte metal, thoſe old wine-pots were caſt, that are ſtill preſerved in the family-houſe, which looks into the market-place, inhabited afterwards by his great-grandſon Gerard Thomas, a gentleman of reputation; whom I mention for the honour of the family, and who died old a few years ſince. A new invention never fails to engage curioſity. And when a commodity never before ſeen excited purchaſers, to the advantage of the inventor, the admiration of the art increaſed, dependents were enlarged, and workmen multiplied; the firſt calamitous incident! Among theſe was one John, whether, as we ſuſpect, he had ominouſly the name of *Fauſtus* (B), unfaithful and unlucky to his maſter, or whether it was really a perſon of that name, I ſhall not much inquire; being unwilling to moleſt the ſilent ſhades, who ſuffer from a conſciouſneſs of their paſt actions in this life. This man, bound by oath to keep the ſecret of printing, when he thought he had learned the art of joining the letters, the method of caſting the types, and other things of that nature, taking the moſt convenient time that was poſſible, on Chriſtmas eve, when every one was cuſtomarily employed in luſtral ſacrifices, ſeizes the collection of types, and all the implements his maſter had got together, and, with one accomplice, marches off to Amſterdam, thence to Cologne, and at laſt ſettled at Mentz, as at an aſylum of ſecurity, where he might go to work with the tools he had ſtolen. It is certain, that in a year's time, viz. in 1442, the *Doctrinale* of Alexander Galius, which was a grammar much uſed at that time, together with the *Tracts* of Peter of Spain, came forth there, from the ſame types as Laurentius had made uſe of at Harlem."

Thus far the narrative of Junius, which he had frequently heard from Nicolaus Galius; to whom it was related by Cornelius himſelf, who lived to a great age, and uſed to burſt into tears upon reflecting on the loſs his maſter had ſuſtained, not only in his ſubſiſtence, but in his honour, by the roguery of his ſervant, his former aſſociate and bedfellow. Cornelius, as appears by the regiſters of Harlem cathedral, died either in 1515, or the beginning of the following year; ſo that he might very well give this information to Nicolaus Galius, who was ſchoolmaſter to Hadrian Junius.

Though this circumſtance is probable as to the main fact, yet we muſt ſet aſide the evidence of it in ſome particulars. 1. The firſt obvious difficulty is noticed by Scriverius; "that the types are ſaid to be made of the *rind* of beech, which could not be ſtrong enough to bear the impreſſion of the preſs:" though this is removed, if, inſtead of the *bark*, we ſubſtitute a *bough* of the beach. The idea of the *bark*, when Junius wrote this, was perhaps ſtrong in his mind, from what Virgil tells us (Ecl. v. 13.) of its being uſual to cut words in the *bark* of a beech; and thence he was eaſily led to make a wrong application of it here.

Bower and Nichols's Origin of Printing.

2. The letters were at firſt *wooden*, and are ſaid to be afterwards exchanged for *metal* types; from which the wine-pots were formed, remaining in the time of Junius. According to tradition, printing was carried on in the ſame houſe long after the time of Laurentius: theſe pots might therefore be formed from the waſte metal of the printing-houſe, after the uſe of *fuſile types* became univerſal.—But Laurentius ſeems to have carried the art no farther than *ſeparate wooden types*. What is a

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(A) Galius ſeems to be the ſame who is called *Claes Lottynſz. Gael*, Scabinus Harlemni, as it is in the Faſti of that city, in the years 1531, 1533, and 1535. Quirinius in the ſame Faſti is called *Mr Quiryn Dirkſzoon*. He was many years amanuenſis to the great Eraſmus, as appears from his epiſtle, 23d July 1529. tom. iii. Oper. p. 1222. He was afterwards Scabinus in 1537 & ſeq. and Conſul in 1552 & ſeq. But in the troubles of Holland he was cruelly killed by the Spaniſh ſoldiers, May 23. 1573. There are ſome letters of Hadrian Junius to this Taleſius, in the *Epiſtolæ Junianæ*, p. 198.

(B) *John Fauſt*, or *Fuſt*, is by many ſuppoſed to have derived his name from *fauſtus*, "happy;" and Dr Fauſtus ſeems to carry an air of grandeur in the appellation: but very erroneouſly. *John Fauſt*, or *Fuſt*, is no more than *John Hand*, whence our name *Fiſt*.

remarkable confirmation of this, Henry Spiechel, who wrote, in the 16th century, a Dutch poem intitled *Hertſpiegel*, expreſſes himſelf thus: "Thou firſt, Laurentius, to ſupply the defect of wooden tablets, adaptedſt *wooden types*, and afterwards didſt connect them with a thread, to imitate writing. A treacherous ſervant ſurreptitiouſly obtained the honour of the diſcovery. But truth itſelf, though deſtitute of common and wide-ſpread fame; truth, I ſay, ſtill remains." No mention in the poem of *metal types;* a circumſtance which, had he been robbed of ſuch, as well as of *wooden* ones, would ſcarcely have been paſſed over in ſilence.

When Laurentius firſt deviſed his rough ſpecimen of the art, can only be gueſſed at. He died in 1440, after having publiſhed the *Speculum Belgicum*, and two editions of *Donatus*, all with different *wooden types;* which it is probable (conſidering the difficulties he had to encounter, and the many artiſts whom he muſt neceſſarily have had occaſion to conſult) coſt him ſome years to execute; ſo that the firſt eſſay might be about 1430, which nearly agrees with Petrus Scriverius, who ſays the invention was about 10 or 12 years before 1440. See LAURENTIUS.

3. What was the ſpecimen he firſt diverted himſelf with in cutting, at the diſtance of three centuries, one would think impoſſible to be diſcovered. And yet Joh. Enſchedius, a printer, thinks he was ſo happy as to find it, being an old parchment *Horarium*, printed on both ſides, in eight pages, containing the Letters of the Alphabet, the Lord's Prayer, the Apoſtles Creed, and three ſhort prayers. And Mr Meerman having ſhown this to proper artiſts who were judges of theſe matters, they gave it as their opinion that it agreed exactly with the deſcription of Junius. It is conformable to the firſt edition of the Dutch *Speculum Salvationis*, and the fragments of both *Donatus's* of Holland, both which are the works of the ſame Laurentius, and were preceded by this. In theſe types, which are certainly moveable, cut, and uneven, there is a rudeneſs which Mr Meerman has not obſerved in any other inſtances. There are no numbers to the pages, no ſignatures, no *direction-words*, no diviſions at the end of the lines; on the contrary, a ſyllable divided in the middle is ſeen, thus, *Spiritū*, in p. 8. l. 2, 3. There are neither diſtinctions nor points, which are ſeen in the other works of Laurentius; and the letter *i* is not marked with an accent, but with a dot at the top. The lines throughout are uneven. The ſhape of the pages not always the ſame; not (as they ſhould be) rectangular, but ſometimes rhomb-like, ſometimes an *iſoſcele trapezium;* and the performance ſeems to be left as a ſpecimen both of his piety, and of his ingenuity in this eſſay of a new invented art. Mr. Meerman has given an exact engraving of this ſingular curioſity.

But, whatever elſe may appear doubtful in the narrative of Junius, it is very clear, that the firſt eſſays of the art are to be attributed to Laurentius, who uſed only *ſeparate wooden types*. See the article LAURENTIUS.

7
Claim of Mentz.

II. Some of Laurentius's types were ſtolen from him by one of his ſervants (c), *John* GEINSFLEICH *ſenior;* who fled therewith to MENTZ. Having introduced the art from Harlem into this his native city, he ſet with all diligence to carry it on; and publiſhed, in 1442, *Alexandri Galli Doctrinale*, *Petri Hispani Tractatus*; two works, which, being ſmall, beſt ſuited his circumſtances; and for which, being much uſed in the ſchools, he might reaſonably expect a profitable ſale. They were executed with *wooden types*, cut after the model of thoſe he had ſtolen.

(c) Authors differ as to the perſon who committed this robbery. It is clear from all accounts that his name was *John;* but what his ſurname was is the diſputed point. Junius, after ſome heſitation, aſcribes it to John Fuſt; but with injuſtice: for he was a wealthy man, who aſſiſted the firſt printers at Mentz with money; and though he afterwards was proprietor of a printing-office, yet he never, as far as appears, performed any part of the buſineſs with his own hands, and conſequently he could never have been a ſervant to Laurentius. Nor is the conjecture of Scriverius better founded, which fixes it upon John Gutenberg, who (as appears by authentic teſtimonies) reſided at Straſburg from 1436 to 1444, and during all that period employed much fruitleſs labour and expence in endeavouring to attain this art. Mr Meerman once thought, "it might be either John Meidenbachius, (who, we are told by Seb. Munſter and the author of *Chronographia Moguntinenſis*, was an aſſiſtant to the firſt Mentz printers); or John Peterſheimius (who was ſome time a ſervant to Fuſt and Schoeffer, and ſet up a printing-houſe at Francfort in 1459): or, laſtly, ſome other perſon, who, being unable through poverty to carry on the buſineſs, diſcovered it to *Geinsfleich* at Mentz." But more authentic intelligence afterwards convinced him there were two perſons of this name; and that John Geinsfleich ſenior† was the diſhoneſt ſervant, who was born at Mentz, and who in the papers publiſhed by Kohlerus, we find there in the year 1441, and not before: for though he was of a good family, yet he was poor, and ſeems to have been obliged, as well as his brother, to ſeek his livelihood in a foreign country; and perhaps was content to be under Laurentius, that, when he had learned the art, he might follow it in his own. But, to leave conjecture, we may produce ſome certain teſtimonies.

1. It is what Junius himſelf ſays, that the perſon who ſtole the types did it with a view to ſet up elſewhere; nor is it likely that he would either make no uſe of an art he had ſeen ſo profitable to Laurentius, or that he would teach it to another and ſubmit to be again a ſervant.

2. The Lambeth Record (which is printed below, from Mr Atkyns) tells us, that "Mentz gained the art by the brother of one of the workmen of Harlem, who learned it at home of his brother, who after ſet up for himſelf at Mentz."—By the ſtricteſt examination of the beſt authorities, it is plain, that by theſe *two brothers* the two Geinsfleiches muſt be meant. But as the younger *(Gutenberg)* was never a ſervant to Laurentius, it muſt be the ſenior who carried off the types, and inſtructed his brother in the art; who firſt applied himſelf to the buſineſs at Straſburg, and afterwards joined his elder brother, who had in the mean time ſettled at Mentz.

† He was called *Geinsfleich* κατ' ἐξοχὴν; the other was diſtinguiſhed by the name of *Gutenberg*. They were both poor; though of a family diſtinguiſhed by knighthood. They were both married men; and were moſt probably brothers, as it was not uncommon in that age for two brothers to have the ſame Chriſtian name. Theſe both appear in a diſreputable light. The eldeſt robbed his maſter, with many aggravating circumſtances. The youngeſt was remarkably contentious; and, after entering into a contract of marriage with Anna, a noble girl of *The Iron Gate*, refuſed to marry her till compelled by a judicial decree; and afterwards cared not what became of the lady, but left her behind at Straſburg when he removed to Mentz. He had not only frequent quarrels with his wife; but with *Andrew Drizehen*, *Andrew Heilmann*, and *John Riff*, all of whom were aſſociated with him at Straſburg in his different employments of making of looking glaſſes, poliſhing of precious ſtones, and endeavouring to attain the art of printing: and with theſe he involved himſelf in three law-ſuits. See *Meerman*, vol. I. p. 163, &c. N.

In 1443 he hired the houſe **Zum Jungen**; and was aſſiſted with money by Fust, a wealthy perſon, who in return had a ſhare of the buſineſs: and about the ſame time *John Meidenbachius* was admitted a partner, as were ſome others whoſe names are not tranſmitted to our times; and in 1444 they were joined by Gutenberg, who for the purpoſe quitted Straſburg. Wooden types being found not ſufficiently durable, and not anſwering expectation in other reſpects, the two brothers firſt invented *cut metal types*. But while theſe were preparing, which muſt have been a work of time, ſeveral works were printed, both on *wooden ſeparate types* and on *wooden blocks*; which were well adapted to ſmall books of frequent uſe, ſuch as the *Tabula Alphabetica*, the *Catholicon*, *Donati Grammatica*, and the *Confeſſionalia*.

From the abovementioned printers in conjunction, after many ſmaller eſſays, the Bible was publiſhed in 1450, with *large cut metal types* (d). And it is no wonder, conſidering the immenſe labour this work coſt, that it ſhould be ſeven or eight years in completing. In this ſame year the partnerſhip was diſſolved, and a new one entered into, in Auguſt, between *Fuſt and Gutenberg*; the former ſupplying the money, the latter ſkill, for their common benefit. Various difficulties ariſing, occaſioned a law-ſuit for the money which Fuſt had advanced; which was determined againſt Gutenberg. A diſſolution of this partnerſhip enſued in 1455; and in 1457 a magnificent edition of the Pſalter was publiſhed by *Fuſt and Schoeffer*, with a remarkable commendation, in which they aſſumed to themſelves the merit of a new invention, (viz. of *metal types*), *ad inventionem artificioſam imprimendi ac characterizandi.* This book was uncommonly elegant, and in ſome meaſure the work of Gutenberg; as it was four years in the preſs, and came out but 18 months after the partnerſhip was diſſolved between him and Fuſt.

The latter continued in poſſeſſion of the printing-office: and *Gutenberg*, by the pecuniary aſſiſtance of Conrad Humery ſyndic of Mentz (e), and others, opened another office in the ſame city; whence appeared, in 1460, without the printer's name, the *Catholicon Jo. de Janua*, with a pompous colophon in praiſe of its beauty, and aſcribing the honour of the invention to the city of Mentz. It was a very handſome book, though inferior to the Pſalter which had been publiſhed in 1457 by Fuſt and Schoeffer. Both the Pſalter and *Catholicon* were printed on *cut metal types* (f). It may not be improper to obſerve here, that as the Pſalter is the earlieſt book which is known to have a genuine date, it became a common practice, after that publication, for printers to claim their own performances, by adding their names to them.

III. The progreſs of the art has been thus traced

What is ſtill ſtronger, two chronologers of Straſburg, the one named *Dan Speklinus*, the other anonymous (in Meerman's *Documenta*, n° lxxxv. lxxxvi.), tells us expreſsly, that John Geinsfleich (viz. the ſenior, whom they diſtinguiſhed from Gutenberg), having learned the art by being ſervant to its *firſt inventor*, carried it by theft into Mentz his native country. They are right in the fact, though miſtaken in the application of it; for they make Straſburg the place of the invention, and Mentelius the inventor, from whom the types were ſtolen. But this is plainly an error: for Geinsfleich lived at Mentz in 1441, as appears from undoubted teſtimonies; and could not be a ſervant to Mentelius, to whom the before mentioned writers aſcribe the invention in 1440, though more ancient ones do not attempt to prove that he began to print before 1444 or 1447. Nor will the narrative agree better with Gutenberg, who was an earlier printer than Mentelius; ſince, among the evidences produced by him in his law-ſuit, 1439, no Geinsfleich ſenior appears, nor any other ſervant but Laurentius Beildek. The narration therefore of the theft of Geinsfleich, being ſpread by various reports through the world, and ſubſiſting in the time of theſe chronologers, was applied by them (to ſerve the cauſe they wrote for) to Straſburg; but ſerves to confirm the truth, ſince no writer derives the printing ſpoils from any other country than Holland or Alſatia. The chronologers have likewiſe, inſtead of Fuſt, called Gutenberg the wealthy man; who, from all circumſtances, appears to have been poor. They alſo call Schoeffer the ſon-in-law of Mentelius; when it is clear that he married the daughter of Fuſt.

(d) Many writers have ſuppoſed that this was the edition of which ſome copies were ſold in France, by Fuſt, as manuſcripts, for the great price of 500 or 600 crowns, which he afterwards lowered to 60, and at laſt to leſs than 40. But it was the ſecond and more expenſive edition of 1462, that was thus diſpoſed of, when Fuſt went to Paris in 1466, and which had coſt 4000 florins before the third *quaternion* (or quire of four ſheets) was printed. Meerman, vol. I. p. 6. 151, 152.

(e) At the death of Gutenberg, Conrad Humery took poſſeſſion of all his printing materials; and engaged to the archbiſhop Adolphus, that he never would ſell them to any one but a citizen of Mentz. They were, however, ſoon diſpoſed of to Nicholas Bechtermuntze of Altavilla, who, in 1469, publiſhed *Vocabularium Latino-Teutonicum*, which was printed with the ſame types which had been uſed in the *Catholicon*. This very curious and ſcarce *Vocabulary* was ſhown to Mr Meerman, by Mr Bryant, in the Duke of Marlborough's valuable library at Blenheim. It is in quarto, 35 lines long, contains many extracts from the *Catholicon*, and is called *Ex quo*, from the preface beginning with thoſe words. Meerman, vol. II. p. 96.

(f) Gutenberg never uſed any other than either *wooden* or *cut metal types* till the year 1462. In 1465 he was admitted *inter Aulicos* by the elector Adolphus, with an annual penſion; and died in February 1468. His elder brother Geinsfleich died in 1462. Their epitaphs are printed by Mr Meerman, vol. II. p. 154, 295.

through its *ſecond* period the invention of *cut metal types*. But the honour of completing the diſcovery is due to Peter Schoeffer (G) de Gernſheim.

8 Invention of caſt types.

A very clear account of this final completion of the types is preſerved by Trithemius (H). *Poſt hæc inventis ſucceſſerunt ſubtiliora, invenerutque modum* fundendi formas *omnium Latini alphabeti literarum, quas ipſi* matrices *nominabant: ex quibus rurſum æneos ſive ſtanneos characteres fundebant, ad omnem preſſuram ſufficientes, quos prius manibus ſculpebant. Et revera ſicuti* ante *xxx* ferme annos *ex ore Petri Opilionis de Gernſheim, civis Moguntini, qui gener erat primi artis inventoris, audivi, magnam a primo inventionis ſuæ hæc ars impreſſoria habuit difficultatem.—Petrus autem memoratus Opilio, tunc famulus poſtea gener, ſicut diximus, inventoris primi, Johannis Fuſt, homo ingenioſus et prudens, faciliorem modum* fundendi characteres *excogitavit, et artem, ut nunc eſt, complevit.*

Another ample teſtimony in favour of Schoeffer is given by Jo. Frid. Fauſtus of Aſchaffenburg, from papers preſerved in his family: "Peter Schoeffer of Gernſheim, perceiving his maſter Fuſt's deſign, and being himſelf ardently deſirous to improve the art, found out (by the good providence of God) the method of cutting *(incidendi)* the characters in a *matrix*, that the letters might eaſily be ſingly *caſt*, inſtead of being *cut*. He privately *cut matrices* for the whole alphabet; and when he ſhowed his maſter the letters caſt from theſe matrices. Fuſt was ſo pleaſed with the contrivance, that he promiſed Peter to give him his only daughter, Chriſtina, in marriage; a promiſe which he ſoon after performed. But there were as many difficulties at firſt with theſe letters, as there had been before with *wooden* ones; the metal being too ſoft to ſupport the force of the impreſſion: but this defect was ſoon remedied, by mixing the metal with a ſubſtance which ſufficiently hardened it (I)."

Fuſt and Schoeffer concealed this new improvement, by adminiſtering an oath of ſecrecy to all whom they intruſted, till the year 1462; when, by the diſperſion of their ſervants into different countries, at the ſacking of Mentz by the archbiſhop Adolphus, the invention was publicly divulged.

The firſt book printed with theſe *improved types* was *Durandi Rationale*, in 1459; at which time, however, they ſeem to have had only *one ſize* of *caſt* letters, all the larger characters which occur being *cut types*, as appears plainly by an inſpection of the book From this time to 1466, Fuſt and Schoeffer continued to print a conſiderable number of books; particularly two famous editions of *Tully's Offices*. In the earlieſt books, they printed more copies on *vellum* than on *paper*, which was the caſe both of their *Bibles* and *Tulley's Offices*. This, however, was ſoon inverted; and *paper* introduced for the greateſt part of their impreſſions; a few only being printed on *vellum* for curioſities, and for the purpoſe of being *illuminated*. How long Fuſt lived, is uncertain; but in 1471 we find Schoeffer was in partnerſhip with *Conrad Henlif* and a kinſman of his maſter Fuſt. He publiſhed many books after the death of his father-in-law; the laſt of which that can be diſcovered is a third edition of the *Pſalter* in 1490, in which the old *cut* types of the firſt edition were uſed.

9 Claim of Straſburg.

IV. With regard to the claim of STRASBURG: It has been already mentioned, that Gutenberg was engaged in that city in different employments; and, among others, in endeavouring to attain the art of printing. That theſe endeavours were unſucceſsful, is plain from an authentic judicial decree of the ſenate of Straſburg in 1439, after the death of Andrew Drizehen (K).

But there are many other proofs that Gutenberg and his partners were never able to bring the art to perfection.

1. Wimphelingius*, the oldeſt writer in favour of Straſburg, tells us, that Gutenberg was the inventor of "a new art of writing," *ars impreſſoria*, which might alſo be called a *divine benefit*, and which he happily completed at Mentz; but does not mention one book of his printing: though he adds, that Mentelius printed many volumes correctly and beautifully, and acquired great wealth; whence we may conclude that he perfected what Gutenberg had in vain eſſayed.

2. Wimphelingius, in another book †, tells us, the art of printing was found out by Gutenberg *incomplete*; which implies, not that he practiſed the art in an imperfect manner (as Laurentius had done at Harlem), but rather that he had not been able to accompliſh what he aimed at.

3. Gutenberg, when he left Straſburg in 1444 or the

* Epitome Rerum Germanicarum ed Argent. 1505, Meerman, vol. i. p. 202. vol. ii. p. 139

† Catal. Epiſc. Argent 1508, Meerman, ut ſupra.

(G) In German, Schoeffer; in Latin, *Opilio*; in Engliſh, *Shepherd*.——He is ſuppoſed by Mr Meerman to have been the firſt engraver on copperplates.

(H) *Annales Hirſaugienſes*, tom. ii. ad ann. 1450.—As this book was finiſhed in 1514, and Trithemius tells us he had the narrative from Schoeffer himſelf about 30 years before; this will bring us back to 1484, when Schoeffer muſt have been advanced in years, and Trithemius about 22 years old, who died in 1516. See *Voſſ.* Hiſt. Lat. l. 1. c. 10. *Fabr*. Med. & Infim. Æt. l. 9.

(I) See *Meerman*, vol. I. 9. 183. who copied this teſtimony from Wolfius, *Monument. Typograph*. vol. i. p. 468. ſeq.

(K) Their firſt attempts were made about 1437 with *wooden types*. Mr Meerman is of opinion that Geinsfleich junior (who was of an enterpriſing genius, and had already engaged in a variety of projects) gained ſome little inſight into the buſineſs by viſiting his brother who was employed by Laurentius at Haerleim, but not ſufficient to enable him to practiſe it. It is certain that, at the time of the law-ſuit in 1439, much money had been expended, without any profit having ariſen; and the unfortunate Drizehen, in 1438, on his death-bed, lamented to his confeſſor, that he had been at great expence, without having been reimburſed a ſingle *obolus*. Nor did Gutenberg (who perſiſted in his fruitleſs endeavours) reap any advantage from them; for, when he quitted Straſburg, he was overwhelmed in debt, and under a neceſſity of ſelling every thing he was in poſſeſſion of. [Meerman, vol. I. p. 198—202.] All the depoſitions in the law-ſuit above-mentioned (with the judicial decree) are printed by Mr Meerman, vol. II. p. 58—88. N.

the following year, and entered into partnerſhip with Geinsfleich ſenior and others, had occaſion for his brother's aſſiſtance to enable him to complete the art; which ſhows that his former attempts at Straſburg had been unſucceſsful ‡.

4. Theſe particulars are remarkably confirmed by Trithemius, who tells us, in two different places||, that Gutenberg ſpent all his ſubſtance in queſt of this art; and met with ſuch inſuperable difficulties, that, in deſpair, he had nearly given up all hopes of attaining it, till he was aſſiſted by the liberality of Fuſt, and by his brother's ſkill, in the city of Mentz.

5. Ulric Zell ſays * the art was completed at Mentz; but that ſome books had been publiſhed in Holland earlier than in that city. Is it likely that Zell, who was a German, would have omitted to mention Straſburg, if it had preceded Mentz in printing?

There is a little doubt therefore that all Gutenberg's labours at Straſburg amounted to no more than a fruitleſs attempt, which he was at laſt under the neceſſity of relinquiſhing: and there is no certain proof of a ſingle book having been printed in that city till after the diſperſion of the printers in 1462, when Mentellius and Eggeſtenius ſucceſsfully purſued the buſineſs.

In fine, the pretenſions of *Straſburg* fall evidently to be ſet aſide. And as to the other two cities, *Harlem* and *Mentz*, the diſputes between them ſeem eaſily cleared up, from the twofold invention of printing abovementioned: the firſt with *ſeparate* WOODEN *types* at Harlem, by Laurentius, about 1430, and after continued by his family; the other with METAL *types* firſt *cut*, and afterwards *caſt*, which were invented at Mentz, but not uſed in Holland till brought thither by Theodoric Martens at Aloſt about 1472.

From this period printing made a rapid progreſs in moſt of the principal towns of Europe. In 1490, it reached Conſtantinople; and, according to Mr Palmer, p. 281, &c. it was extended, by the middle of the next century, to Africa and America. It was introduced into Ruſſia about 1560; but, from motives either of policy or ſuperſtition, it was ſpeedily ſuppreſſed by the ruling powers; and, even under the preſent enlightened empreſs, has ſcarcely emerged from its obſcurity.—That it was early practiſed in the inhoſpitable regions of Iceland, we have the reſpectable authority of Mr Bryant: "Arngrim Jonas was born amidſt the ſnows of Iceland; yet as much prejudiced in favour of his country as thoſe who are natives of an happier climate. This is viſible in his *Crymogæa;* but more particularly in his *Anatome Bleſkiniana*. I have in my poſſeſſion this curious little treatiſe, written in Latin by him in his own country, and printed *Typis Holenſibus in Iſlandiâ Boreali, anno* 1612. *Hola* is placed in ſome maps within the Arctic circle, and is certainly not far removed from it. I believe it is the fartheſt north of any place where arts and ſciences have ever reſided." *Obſervations and Inquiries relating to various parts of Ancient Hiſtory*, 1767, p. 277.

10 Introduction of the art into Britain.

It was a conſtant opinion, delivered down by our hiſtorians, as hath been obſerved by Dr Middleton, that the Art of Printing was introduced and firſt practiſed in England by *William Caxton*, a mercer, and citizen of London; who, by his travels abroad, and a reſidence of many years in Holland, Flanders, and Germany, in the affairs of trade, had an opportunity of informing himſelf of the whole method and proceſs of the art; and by the encouragement of the great, and particularly of the abbot of Weſtminſter, firſt ſet up a preſs in that abbey, and began to print books ſoon after the year 1471.

This was the tradition of our writers; till a book, which had ſcarce been obſerved before the Reſtoration, was then taken notice of by the curious, with a date of its impreſſion from Oxford, *anno* 1468, and was conſidered immediately as a clear proof and monument of the exerciſe of printing in that univerſity ſeveral years before Caxton began to deal in it.

This book, which is in the public library at Cambridge, is a ſmall volume of 41 leaves in 4to, with this title; *Expoſitio Sancti Jeronimi in Simbolum Apoſtolorum ad Papam Laurentium:* and at the end, *Explicit expoſitio, &c. Impreſſa Oxonie, & finita Anno Domini* M.CCCC.LXVIII. XVII *die Decembris.*

11 The firſt printing-preſs ſet up in England was at Oxford.

The appearance of this book has robbed Caxton of a glory that he had long poſſeſſed, of being the author of printing in England; and Oxford has ever ſince carried the honour of the firſt preſs. The only difficulty was, to account for the ſilence of hiſtory in an event ſo memorable, and the want of any memorial in the univerſity itſelf concerning the eſtabliſhment of a new art amongſt them of ſuch uſe and benefit to learning. But this likewiſe has been cleared up by the diſcovery of a record, which had lain obſcure and unknown at Lambeth-palace, in the Regiſter of the See of Canterbury; and gives a narrative of the whole tranſaction, drawn up at the very time.

An account of this record was firſt publiſhed in a thin quarto volume, in Engliſh; with this title: "The Original and growth of Printing, collected out of Hiſtory and the Records of this Kingdom: wherein is alſo demonſtrated, that Printing appertaineth to the Prerogative Royal, and is a Flower of the Crown of England. By Richard Atkyns, eſq.—Witehall, April the 25, 1664. By order and appointment of the right honourable Mr Secretary Morrice, let this be printed. Tho. Rycaut. London: Printed by John Streater, for the Author. 1664." 4to.

It ſets forth in ſhort, "That as ſoon as the art of printing made ſome noiſe in Europe, Thomas Bourchier, archbiſhop of Canterbury, moved the then king (Henry VI.) to uſe all poſſible means for procuring a printing-mould (for ſo it was then called) to be brought into this kingdom. The king (a good man, and much given to works of this nature) readily hearkened to the motion; and, taking private advice how to effect his deſign, concluded it could not be brought about without great ſecrecy, and a conſiderable ſum of money given to ſuch perſon or perſons as would draw off ſome of the workmen of Harlem in Holland, where John Gutenberg had newly invented it, and was himſelf perſonally at work. It was reſolved, that leſs than 1000 merks would not produce the deſired effect; towards which ſum the ſaid archbiſhop preſented the king 300 merks. The money being now prepared, the management of the deſign was committed to Mr Robert Turnour; who then was maſter of the robes to the king, and a perſon moſt in favour with him of any of his condition. Mr Turnour took to his aſſiſtance Mr Caxton, a citizen of good abilities, who traded much into Holland; which was a credible pretence, as well for his going, as ſtay in the Low Countries. Mr Turnour was in diſguiſe

(his

‡ Meerman ut ſupra.

|| Annal. Hirſaug. ut ſupra, et Chron, Spanheim. See Meerman, vol. ii. p. 103. 127.

* Chronicon Coloniæ, 1499.

(his beard and hair ſhaven quite off); but Mr Caxton appeared known and public. They, having received the ſaid ſum of 1000 merks, went firſt to Amſterdam, then to Leyden, not daring to enter Harlem itſelf; for the town was very jealous, baving impriſoned and apprehended divers perſons who came from other parts for the ſame purpoſe. They ſtaid till they had ſpent the whole thouſand merks in gifts and expences: ſo as the king was fain to ſend 500 merks more, Mr Turnour having written to the king that he had almoſt done his work; a bargain, as he ſaid, being ſtruck betwixt him and two Hollanders, for bringing off one of the underworkmen, whoſe name was Frederick Corſells (or rather Corſellis), who late one night ſtole from his fellows in diſguiſe into a veſſel prepared before for that purpoſe; and ſo, the wind favouring the deſign, brought him ſafe to London. It was not thought ſo prudent to ſet him on work at London: but, by the archbiſhop's means (who had been vice-chancellor and afterwards chancellor of the univerſity of Oxon) Corſellis was carried with a guard to Oxon; which guard conſtantly watched, to prevent Corſellis from any poſſible eſcape, till he had made good his promiſe in teaching them how to print. So that at Oxford printing was firſt ſet up in England, which was before there was any printing-preſs or printer in France, Spain, Italy, or Germany (except the city of Mentz), which claims ſeniority, as to printing, even of Harlem itſelf, calling her city, *Urbem Moguntinam artis typographicæ inventricem primam;* though it is known to be otherwiſe, that city gaining the art by the brother of one of the workmen of Harlem, who had learnt it at home of his brother, and after ſet up for himſelf at Mentz. This preſs at Oxon was at leaſt ten years before there was any printing in Europe, except at Harlem and Mentz, where it was but new-born. This preſs at Oxford was afterwards found inconvenient to be the ſole printing-place of England; as being too far from London and the ſea. Wherefore the king ſet up a preſs at St Alban's, and another in the city of Weſtminſter, where they printed ſeveral books of *divinity* and *phyſic: for the king* (for reaſons beſt known to himſelf and council) *permitted then no law-books to be printed*; nor did any printer exerciſe that art, but only ſuch as were the king's ſworn ſervants; *the king himſelf having the price and emolument for printing books.*—By this means the art grew ſo famous, that anno primo Richard III. c. 9. when an act of parliament was made for reſtraint of aliens for uſing any handicrafts here (except as ſervants to natives), a ſpecial proviſo was inſerted, that ſtrangers might bring in printed or written books to ſell at their pleaſure, and exerciſe the art of printing here, notwithſtanding that act: ſo that in the ſpace of 40 or 50 years, by the indulgence of Edward IV. Edward V. Richard III. Henry VII. and Henry VIII. the Engliſh proved ſo good proficients in printing, and grew ſo numerous, as to furniſh the kingdom with books; and ſo ſkilful, as to print them as well as any beyond the ſeas; as appears by the act 25 Hen. VIII. c. 15. which abrogates the ſaid proviſo for that reaſon. And it was further enacted in the ſaid ſtatute, that if any perſon bought foreign books bound, he ſhould pay 6s. 8d. *per* book. And it was further provided and enacted, that in caſe the ſaid printers or ſellers of books were unreaſonable in their prices, they ſhould be moderated by the lord chancellor, lord treaſurer, the two lords chief juſtices, or any two of them; who alſo had power to fine them 3s. 4d. for every book whoſe price ſhould be enhanced.—But when they were by charter corporated with *bookbinders, bookſellers,* and *founders of letters,* 3 & 4 Philip and Mary, and called *the Company of Stationers*—they kick'd againſt the power that gave them life, &c.—Queen Eliſabeth, the firſt year of her reign, grants by patent *the privilege of ſole printing all books that touch or concern the common laws of England,* to Tottel a ſervant to her majeſty, who kept it entire to his death; after him, to one Yeſt Weirt, another ſervant to her majeſty; after him, to Weight and Norton; and after them, king James grants the ſame privilege to More, one of the ſignet; which grant continues to this day, &c."

11 Whether Caxton or Corſellis was the firſt printer.

From the authority of this record, all our late writers declare Corſellis to be the firſt printer in England; Mr Anthony Wood, the learned Mr Maittaire, Palmer, and one John Bagford, an induſtrious man, who had publiſhed propoſals for an Hiſtory of Printing, (Phil. Tranſ. for April 1707). But Dr Middleton has called in queſtion the authenticity of this account, and has urged ſeveral objections to it, with the view of ſupporting Caxton's title to the precedency with reſpect to the introduction of the art into this country; of which we ſhall quote one or two, with the anſwers that have been made to them.

Objection 1.—"The ſilence of Caxton concerning a fact in which he is ſaid to be a principal actor, is a ſufficient confutation of it: for it was a conſtant cuſtom with him, in the prefaces or concluſions of his works, to give an hiſtorical account of all his labours and tranſactions, as far as they concerned the publiſhing and printing of books. And, what is ſtill ſtronger, in the continuation of the Polychronicon, compiled by himſelf, and carried down to the end of Henry the ſixth's reign, he makes no mention of the expedition in queſt of a printer: which he could not have omitted, had it been true; whilſt in the ſame book he takes notice of the invention and beginning of printing in the city of Mentz."

Anſwer.—As Caxton makes no mention in his Polychronicon of his *expedition in queſt of a printer;* ſo neither does he of his *bringing the art into England,* which it is as much a wonder he ſhould omit as the other. And as to his ſaying that *the invention of printing was at Mentz,* he means, of printing on *fuſile* ſeparate types. In this he copies, as many others have, from the *Faſciculus Temporum;* a work written in 1470, by Wernerus Rolevinch de Laer, a Carthuſian monk, a MS. copy of which was in the library of Gerard Jo. Voſſius (ſee lib. iii. *de Hiſtor. Latin.* c. 6.); and afterwards continued to the year 1474, when it was firſt printed at Cologne *typis Arnoldi ter Huernen.* It was republiſhed in 1481 by Heinricus Wirczburgh de Vach, a Cluniac monk, without mentioning the name either of the printer or of the place of publication. It is plain that Caxton had one at leaſt, or more probably both, of theſe editions before him, when he wrote his continuation of Polychronicon, as he mentions this work in his preface, and adopts the ſentiments of its editor. (See MEERMAN, vol. ii. p. 37. and his *Documenta,* N° VII. XXIV. and XXV.)

Obj. 2. "There is a farther circumſtance in Caxton's hiſtory, that it ſeems inconſiſtent with the record; for we find him ſtill beyond ſea, about twelve years after the ſuppoſed tranſactions, "learning with great charge and trouble the art of printing" (*Recule of the Hiſtories of Troye*, in the end of the 2d and 3d books); which he might have done with eaſe at home, if he had got Corſellis into his hands, as the record imports, ſo many years before: but he probably learnt it at Cologne, where he reſided in 1471, (*Recule*, &c. ibid.), and whence books had been firſt printed with date the year before."

Anſ.—Caxton tells us, in the preface to *The Hiſtory of Troy*, that he began that tranſlation March 1. 1468, at Bruges; that he proceeded on with it at Ghent; that he finiſhed it at Cologne in 1471; and printed it, probably, in that city with his own types. He was 30 years abroad, chiefly in Holland; and lived in the court of Margaret ducheſs of Burgundy, ſiſter of Edward IV. It was therefore much eaſier to print his book at Cologne, than to croſs the ſea to learn the art at Oxford. But further, there was a ſpecial occaſion for his printing it abroad. Corſellis had brought over ſo far the art of printing as he had learned it at Harlem, which was the method of printing on *wooden ſeparate* types, having the face of the letter cut upon them. But the art of *caſting* metal types being divulged in 1462 by the workmen of Mentz, Caxton thought proper to learn that advantageous branch before he returned to England. This method of caſting the types was ſuch an improvement, that they looked on it as the *original* of printing; and Caxton, as moſt others do, aſcribes that to Mentz.—Caxton was an aſſiſtant with Turnour in getting off Corſellis; but it is nowhere ſuppoſed that he came with him into England. (See MEERMAN, vol. ii. p. 34. B.)

Obj. 3.—"As the Lambeth record was *never heard of before the publication of Atkyn's book*, ſo it has never ſince been ſeen or produced by any man; though the regiſters of Canterbury have on many occaſions been diligently and particularly ſearched for it. They were examined, without doubt, very carefully by archbiſhop Parker, for the compiling his *Antiquities of the Britiſh Church*; where, in the life of Thomas Bourchier, tho' he congratulates that age on the noble and uſeful invention of printing, yet he is ſilent as to the introduction of it into England by the endeavours of that archbiſhop: nay, his giving the honour of the invention to Straſburg clearly ſhows that he knew nothing of the ſtory of Corſellis conveyed from Harlem, and that the record was not in being in his time. Palmer himſelf owns, "That it is not to be found there now; for that the late earl of Pembroke aſſured him, that he had employed a perſon for ſome time to ſearch for it, but in vain:" (*Hiſt. of Printing*, p. 314.) On theſe grounds we may pronounce the record to be a forgery; though all the writers abovementioned take pains to ſupport its credit, and call it an *authentic piece*.

Atkyns, who by his manner of writing ſeems to have been *a bold and vain man*, might poſſibly be *the inventor*: for he had an intereſt in impoſing it upon the world, in order to confirm the argument of his book, that *printing was of the prerogative royal*; in oppoſition to the *company of ſtationers*, with whom he was engaged in an expenſive ſuit of law, in defence of the *king's patents*, under which he claimed *ſome excluſive powers of printing*. For he tells us, p. 3. 'That, upon conſidering the thing, he could not but think that a public perſon, more eminent than a mercer, and a public purſe, muſt needs be concerned in ſo public a good: and the more he conſidered, the more inquiſitive he was to find out the truth. So that he had formed his hypotheſis before he had found his record; which he publiſhed, he ſays, as a friend to truth; not to ſuffer one man to be intitled to the worthy atchievements of another; and as a friend to himſelf, not to loſe one of his beſt arguments of entitling the king to this art.' But, if Atkyns was not himſelf the contriver, he was impoſed upon at leaſt by ſome more crafty man; who imagined that his intereſt in the cauſe, and the warmth that he ſhowed in proſecuting it, would induce him to ſwallow for genuine whatever was offered of the kind."

Anſ.—On the other hand, is it likely that Mr Atkyns would dare to *forge* a record, to be laid before the king and council, and which his adverſaries, with whom he was at law, could diſprove?—(2.) He ſays he received this hiſtory from a perſon of honour, who was ſome time keeper of the Lambeth library. It was eaſy to have confuted this evidence, if it was falſe, when he publiſhed it, April 25. 1664.—(3.) John Bagford (who was born in England 1651, and might know Mr Atkyns, who died in 1677), in his Hiſtory of Printing at Oxford, blames thoſe who doubted of the authenticity of the Lambeth MS.; and tells us that he knew Sir John Birkenhead had an authentic copy of it, when in 1665 [which Bagford by ſome miſtake calls 1664, and is followed in it by Meerman] he was appointed by the houſe of commons to draw up a bill relating to the exerciſe of that art. This is confirmed by the Journals of that houſe, Friday Oct. 27. 1665. vol. VIII. p. 622. where it is ordered, that this Sir John Birkenhead ſhould carry the bill on that head to the houſe of lords for their conſent.—The act was agreed to in the upper houſe on Tueſday Oct. 31. and received the royal aſſent on the ſame day; immediately after which the parliament was prorogued. See *Journals of the Houſe of Lords*, Vol. XI. p. 700.—Is it probable, then, that after Mr Atkyns had publiſhed his book in April 1664, the parliament thought proper, the next year, to inquire into *the right of the king's prerogative*; and that Sir John Birkenhead took care to inſpect the original, then in the cuſtody of archbiſhop Sheldon: and, finding it not ſufficient to prove what Mr Atkyns had cited it for, made no report of the MS. to the houſe; but only moved, that the former law ſhould be renewed. The MS. was probably never returned to the proper keeper of it; but was afterwards burnt in the fire of London, Sept. 13. 1666.—(4.) That printing was practiſed at Oxford, was a prevailing opinion long before Atkyns. Bryan Twyne, in his *Apologia pro Antiquitate Academiæ Oxonienſis*, publiſhed 1608, tells us, it is ſo delivered down in *ancient writings*; having heard, probably, of this Lambeth MS. And king Charles I. in his letters patent to the Univerſity of Oxford, March 5. in the eleventh of his reign, 1635, mentions printing as brought to *Oxford* from abroad. As to what is objected, "that it is not likely that the preſs ſhould undergo a ten or eleven years ſleep, viz. from 1468 to 1479," it is probably urged without foundation. Corſellis might print ſeveral books without date or name of the place, as Ulric Zell did at Cologne, from 1467 to 1473, and from that time to 1494. Corſellis's name, it may be ſaid, appears not in any of his publications; but neither does that of Joannes Peterſhemius. [See MEERMAN, vol. I. p. 34.; vol. II. p. 21—27, &c.

Further, the famous Shakeſpeare, who was born in 1564, and died in 1616, in the Second Part of Henry VI. act iv. ſc. 7. introduces the rebel John Cade, thus upbraiding Lord Treaſury Say: "Thou haſt moſt traiterouſly corrupted the youth of the realm, in creating a grammar-ſchool: and whereas, before, our forefathers had no other book but the ſcore and the tally, thou haſt cauſed *Printing* to be uſed; and, contrary to the king, his crown, and dignity, thou haſt built a paper-mill."—Whence now had Shakeſpeare this accuſation againſt lord Say? We are told in the Poetical Regiſter, vol. II. p. 231. ed. Lond. 1724, that it was from Fabian, Pol. Vergel, Hall, Hollingſhed, Grafton, Stow, Speed. &c. But not one of theſe aſcribes printing to the reign of Henry VI. On the contrary, Stow, in his Annals, printed at London 1560, p. 686, gives it expreſsly to William Caxton, 1471. "The noble ſcience of printing was about this time found out in Germany at Magunce, by one John Guthumburgus a knight. One Conradus an Almaine brought it into Rome: William Caxton of London mercer, brought it into England about the year 1471, and firſt practiſed the ſame in the Abbie of St Peter at Weſtminſter; after which time it was likewiſe practiſed in the Abbies of St Auguſtine at Canterburie, Saint Albons, and other monaſteries of England." What then ſhall we ſay, that the above is an anachroniſm arbitrarily put into the mouth of an ignorant fellow out of Shakeſpeare's head? We might believe ſo, but that we have the record of Mr Atkyns confirming the ſame in king Charles II.'s time. Shall we ſay, that Mr Atkyns borrowed the ſtory from Shakeſpeare, and publiſhed it with ſome improvements of money laid out by Henry VI. from whence it might be received by Charles II. as a prerogative of the crown? But this is improbable, ſince Shakeſpeare makes Lord Treaſurer Say the inſtrument of importing it, of whom Mr Atkyns mentions not a word. Another difference there will ſtill be between Shakeſpeare and the Lambeth MS.; the poet placing it before 1449, in which year Lord Say was beheaded; the MS. between 1454 and 1459, when Bourchier was archbiſhop. We muſt ſay, then, that lord Say firſt laid the ſcheme, and ſent ſome one to Harlem, though without ſucceſs; but after ſome years it was attempted happily by Bourchier. And we muſt conclude, that as the generality of writers have overlooked the invention of printing at Harlem with *wooden* types, and have aſcribed it to Mentz where *metal* types were firſt made uſe of; ſo in England they have paſſed by Corſellis (or the firſt *Oxford Printer*, whoever he was, who printed with *wooden* types at Oxford), and only mentioned Caxton as the original artiſt who printed with *metal* types at Weſtminſter. [See MEERMAN, vol. ii. 7, 8.] It is ſtrange, that the learned commentators on the great dramatic poet, who are ſo minutely particular upon leſs important occaſions, ſhould every one of them, Dr Johnſon excepted, paſs by this curious paſſage, leaving it entirely unnoticed. And how has Dr Johnſon trifled, by ſlightly remarking, "that Shakeſpeare is a little *too early* with this accuſation!"—The great critic had undertaken to decipher obſolete words, and inveſtigate unintelligible phraſes; but never, perhaps, beſtowed a thought on Caxton or Corſellis, on Mr Atkyns or the authenticity of the Lambeth Record.

But, independent of the record altogether, the book ſtands firm as a monument of the exerciſe of printing in Oxford ſix years older than any book of Caxton's with a date. In order to get clear of this ſtrong fact Dr Middleton,

1. Suppoſes the date in queſtion to have been falſified originally by the printer either by deſign or miſtake; and an X to have been dropped or omitted in the age of its impreſſion. Examples of this kind, he ſays, are common in the hiſtory of printing. And, "whilſt I am now writing, an unexpected inſtance is fallen into my hands, to the ſupport of my opinion; an *Inauguration Speech of the Woodwardian Profeſſor, Mr Maſon*, juſt freſh from the preſs, with its date given 10 years earlier than it ſhould have been, by the omiſſion of an x, viz. MDCCXXIV; and the very blunder exemplified in the laſt piece printed at Cambridge, which I ſuppoſe to have happened in the firſt from Oxford."——To this it has been very properly anſwered, That we ſhould not pretend to ſet aſide the authority of *a plain date*, without very ſtrong and cogent reaſons; and what the Doctor has in this caſe advanced will not appear, on examination, to carry that weight with it that he ſeems to imagine. There may be, and have been, miſtakes and forgeries in the date both of books and of records too; but this is never allowed as a reaſon for ſuſpecting ſuch as bear no mark of either. We cannot from a blunder in the laſt book printed at Cambridge, infer a like blunder in the firſt book printed at Oxford. Beſides, the *type* uſed in this our Oxford edition ſeems to be no ſmall proof of its antiquity. It is the German letter, and very nearly the ſame with that uſed by Fuſt [who has been ſuppoſed to be] the firſt printer; whereas Caxton and Rood uſe a quite different letter, ſomething between this German and our old Engliſh letter, which was ſoon after introduced by De Worde and Bynſon.

2. "For the probability of his opinion (he ſays), the book itſelf affords ſufficient proof: for, not to inſiſt on what is leſs material, the *neatneſs of the letter, and regularity of the page*, &c. above thoſe of Caxton, it has one mark, that ſeems to have carried the matter beyond probable, and to make it even certain, viz. *the uſe of ſignatures*, or letters of the alphabet placed at the bottom of the page, to ſhow the ſequel of the pages and leaves of each book; an improvement contrived for the direction of the bookbinders; which yet was not practiſed or invented at the time when this book is ſuppoſed to be printed; for we find no ſignatures in the books of Fauſt or Schoeffer at Mentz, nor in the improved or beautiful impreſſions of John de Spira and Jenſon at Venice, till ſeveral years later. We have a book in our library, that ſeems to fix the very time of their invention, at leaſt in Venice; the place where the art itſelf received the greateſt improvements: *Baldi lectura ſuper Codic. &c.* printed by *John de Colonia* and *Jo. Manthem de Gherretzem anno* MCCCCLXXIIII. It is a large and fair volume in folio, *without ſignatures*, till about the middle of the book, in which they are firſt introduced, and ſo continued forward: which makes it probable, that the firſt thought of them was ſuggeſted during the impreſſion; for we have likewiſe *Lectura Bartholi ſuper Codic.* &c. in two noble and beautiful volumes in folio, printed

the year before at the ſame place, by Vindelin de Spira, without them: yet from this time forward they are gerally found in all the works of the Venetian printers, and from them propagated to the other printers of Europe. They were uſed at (L) Cologne, in 1475; at Paris, 1476; by Caxton, not before 1480: but if the diſcovery had been brought into England, and practiſed at Oxford 12 years before, it is not probable that he would have printed ſo long at Weſtminſter without them. Mr Palmer indeed tells us, p. 54, 180, that Anthony Zarot was eſteemed the inventor of ſignatures; and that they are found in a Terence printed by him at Milan in the year 1470, in which he firſt printed. I have not ſeen that Terence; and can only ſay, that I have obſerved the want of them in ſome later works of this, as well as of other excellent printers of the ſame place. But, allowing them to be in the Terence, and Zarot the inventor, it confutes the date of our Oxford book as effectually as if they were of later origin at Venice; as I had reaſon to imagine, from the teſtimony of all the books that I have hitherto met with."——As to theſe proofs, firſt, the neatneſs of the letter, and the regularity of the page, prove, if any thing, the very reverſe of what the Doctor aſſerts. The art of printing was almoſt in its infancy brought to perfection; but afterwards debaſed by later printers, who conſulted rather the cheapneſs than the neatneſs of their work. Our learned diſſertator cannot be unacquainted with the labours of Fuſt and Jenſon. He muſt know, that though other printers may have printed more correctly, yet ſcarce any excel them, either in the neatneſs of the letter, or the regularity of the page. The ſame may be obſerved in the Engliſh printers. Caxton and Rood were indifferently good printers; de Worde and Pynſon were worſe; and thoſe that follow them moſt abominable. This our *anonymous Oxford printer* excels them all; and for this very reaſon we ſhould judge him to be the moſt ancient of all. Our diſſertator lays great ſtreſs on the uſe of ſignatures. But no certain concluſion can be drawn either from the uſe or non-uſe of theſe leſſer improvements of printing. They have in different places come in uſe at different times, and have not been continued regularly even at the ſame places. If Anthony Zarot uſed them at Milan in 1470, it is certain later printers there did not follow his example; and the like might happen alſo in England. But, what is more full to our purpoſe, we have in the Bodleian library an Æſop's Fables printed by Caxton. This is, it is believed, the firſt book which has *the leaves numbered*. But yet this improvement, though more uſeful than that of the ſignatures, was diſuſed both by Caxton himſelf and other later printers in England. It is therefore not at all ſurpriſing (if true) that the ſignatures, though invented by our Oxford printer, might not immediately come into general uſe. And conſequently, this particular carries with it no ſuch certain or effectual confutation as our diſſertator boaſts of.

3. What the Doctor thinks farther confirms his opinion is, "That, from the time of the pretended date of this book, *anno* 1468, we have no other fruit or production from the preſs at Oxford for 11 years next following; and it cannot be imagined that a preſs, eſtabliſhed with ſo much pains and expence, could be ſuffered to be ſo long idle and uſeleſs."—To this it may be anſwered, in the words of Oxonides, 1ſt, That his books may have been loſt. Our firſt printers, in thoſe days of ignorance, met with but ſmall encouragement; they printed but few books, and but few copies of thoſe books. In after-times, when the ſame books were reprinted more correctly, thoſe firſt editions, which were not as yet become curioſities, were put to common uſes. This is the reaſon that we have ſo few remains of the firſt printers. We have only four books of Theodoric Rood, who ſeems by his own verſes to have been a very celebrated printer. Of John Lettou-William de Machlinia, and the ſchoolmaſter of St Alban's, we have ſcarce any remains. If this be conſidered, it will not appear *impoſſible* that our printer ſhould have followed his buſineſs from 1468 to 1479, and yet time have deſtroyed his intermediate works. But, 2dly, We may account ſtill another way for this diſtance of time, without altering the date. The Civil Wars broke out in 1469: this might probably oblige our Oxford printer to ſhut up his preſs; and both himſelf and his readers be otherwiſe engaged. If this were the caſe, he might not return to his work again till 1479; and the next year, not meeting with that encouragement he deſerved, he might remove to ſome other country with his types.

Dr Middleton concludes with apologiſing for his "ſpending ſo much pains on an argument ſo inconſiderable, to which he was led by his zeal to do a piece of juſtice to the memory of our worthy countryman William Caxton; nor ſuffer him to be robbed of the glory, ſo clearly due to him, of having *firſt imported into this kingdom* an art of great uſe and benefit to mankind: a kind of merit that, in the ſenſe of all nations, gives the beſt title to true praiſe, and the beſt claim to be commemorated with honour to poſterity."

23
The real claims of Caxton and Corſellis reſpectively.

The fact, however, againſt which he contends, but which it ſeems impoſſible to overturn, does by no means derogate from the honour of Caxton, who, as has been ſhown, was the firſt perſon in England that practiſed the art of printing with *fuſile types*, and conſequently the firſt who brought it to perfection; whereas Corſellis printed with *ſeparate cut types in wood*, being the only method which

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(L) Dr Middleton is miſtaken in the time and place of the invention of ſignatures. They are to be found even in very ancient MSS. which the earlieſt printers very ſtudiouſly imitated; and they were even uſed in ſome editions from the office of Lawrence Coſter (whence Corſellis came), which conſiſted of wooden cuts, as in *Figuræ typicæ et antitypicæ Novi Teſtamenti*; and in ſome editions with metal types, as in *Gaſp. Pergamenſis epiſtolæ*, publiſhed at Paris, without a date, but printed A. D. 1470, (Maittaire *, Annal. vol. i. p. 25.); and in *Mammetrectus*, printed by Helias de Llouffen, at Bern in Switzerland, 1470; and in *De Tondeli viſione*, at Antwerp, 1472. Venice, therefore, was not the place where they were firſt introduced.—They began to be uſed in *Baldus*, it ſeems, when the book was half finiſhed. The printer of that book might not know, or did not think, of the uſe of them before. See *Meerman*, vol. ii. p. 18.; and *Phil. Tranſ.* vol. xxiii. n° 208. p. 1509.

* See Maittaire.

which he had learned at Harlem. Into this detail, therefore, we have been led, not ſo much by the importance of the queſtion, as on account of ſeveral anecdotes connected with it, which ſeemed equally calculated to ſatisfy curioſity and afford entertainment.

Caxton had been bred very reputably in the way of trade, and ſerved an apprenticeſhip to one Robert Large a mercer; who, after having been ſheriff and lord mayor of London, died in the year 1441, and left by will, as may be ſeen in the prerogative-office, XXIIII merks to his apprentice William Caxton: a conſiderable legacy in thoſe days, and an early teſtimonial of his good character and integrity.

From the time of his maſter's death, he ſpent the following thirty years beyond ſea in the buſineſs of merchandiſe: where, in the year 1464, we find him employed by Edward IV. in a public and honourable negociation, jointly with one Richard Whitehill, Eſq; to tranſact and conclude a treaty of commerce between the king and his brother-in-law the duke of Burgundy, to whom Flanders belonged. The commiſſion ſtyles them, *ambaſſiatores, procuratores, nuncios, & deputatos ſpeciales*; and gives to both or either of them full powers to treat, &c.

Whoever turns over his printed works, muſt contract a reſpect for him, and be convinced that he preſerved the ſame character through life, of an honeſt, modeſt, man; greatly induſtrious to do good to his country, to the beſt of his abilities, by ſpreading among the people ſuch books as he thought uſeful to religion and good manners, which were chiefly tranſlated from the French. The novelty and uſefulneſs of his art recommended him to the ſpecial notice and favour of the great; under whoſe protection, and at whoſe expence, the greateſt part of his works were publiſhed. Some of them are addreſſed to king Edward IV. his brother the duke of Clarence, and their ſiſter the ducheſs of Burgundy; in whoſe ſervice and pay he lived many years before he began to print, as he often acknowledges with great gratitude. He printed likewiſe for the uſe, and by the expreſs order, of Henry VII. his ſon prince Arthur, and many of the principal nobility and gentry of that age.

It has been generally aſſerted and believed, that all his books were printed in the abbey of Weſtminſter; yet we have no aſſurance of it from himſelf, nor any mention of the place before the year 1477: ſo that he had been printing ſeveral years without telling us where.

There is no clear account left of Caxton's age: but he was certainly very old, and probably above fourſcore, at the time of his death. In the year 1471 he complained of the infirmities of age creeping upon him, and feebling his body: yet he lived 23 years after, and purſued his buſineſs, with extraordinary diligence, in the abbey of Weſtminſter, till the year 1494, in which he died; not in the year following, as all who write of him affirm. This appears from ſome verſes at the end of a book, called "Hilton's Scale of Perfection," printed in the ſame year:

Infynite laud with thankynges many folde
  I yield to God me ſocouryng with his grace
This boke to finyſhe which that ye beholde
  Scale of Perfection calde in every place
Whereof th' auctor Walter Hilton was
  And Wynkyn de Worde this hath ſett in print
In William Caxſtons hows ſo fyll the caſe,
  God reſt his ſoule. In joy ther mot it ſtynt.
      Impreſſus anno ſalutis MCCCCLXXXXiiii.

Though he had printed for the uſe of Edward IV. and Henry VII. yet there appears no ground for the notion which Palmer takes up, that the firſt printers, and particularly Caxton, were ſworn ſervants and printers to the crown; for Caxton, as far as can be obſerved, gives not the leaſt hint of any ſuch character or title; though it ſeems to have been inſtituted not long after his death; for of his two principal workmen, Richard Pynſon and Wynkyn de Worde, the one was made printer to the king, the other to the king's mother the Lady Margaret. Pynſon gives himſelf the firſt title, in *The Imitation of the Life of Chriſt*; printed by him at the commandment of the Lady Margaret, who had tranſlated the fourth book of it from the French, in the year 1504: and Wynkyn de Worde aſſumes the ſecond, in *The ſeven Penitential Pſalms*, expounded by Biſhop Fiſher, and printed in the year 1509. But there is the title of a book given by Palmer, that ſeems to contradict what is here ſaid of Pynſon: viz. *Pſalterium ex mandato victorioſiſſimi Angliæ Regis Henrici Septimi, per Gulielmum Fanque, impreſſorem regium*, anno MDIIII; which being the only work that has ever been found of this printer, makes it probable that he died in the very year of its impreſſion, and was ſucceeded immediately by Richard Pynſon. No book hath yet been diſcovered printed in Scotland in this period, though the Engliſh printers were able to export ſome of their works to other countries. See Henry's *Hiſtory of Great Britain*, vol. v. p. 471.

14
Different characters when firſt uſed in printing.

Before 1465, the uniform character was the old *Gothic* or *German*; whence our *Black* was afterwards formed. But in that year an edition of Lactantius was printed in a kind of Semi-Gothic, of great elegance, and approaching nearly to the preſent *Roman* type; which laſt was firſt uſed at Rome in 1467, and ſoon after brought to great perfection in Italy, particularly by Jenſon.

Towards the end of the fifth century, Aldus invented the *Italic* character which is now in uſe, called, from his name, *Aldine* or *curſivus*. This ſort of letter he contrived, to prevent the great number of abbreviations that were then in uſe.

15
Of the firſt Greek printing.

The firſt eſſays in Greek that can be diſcovered are a few ſentences which occur in the edition of Tully's *Offices*, 1465, at Mentz; but theſe were miſerably incorrect and barbarous, if we may judge from the ſpecimens Mr Maittaire has given us, of which the following is one:

Οτιcαταακαρτμακατα και τατωτωκα.

In the ſame year, 1465, was publiſhed an edition of Lactantius's *Inſtitutes*, printed *in monaſterio Sublacenſi*, in the kingdom of Naples, in which the quotations from the Greek authors are printed in a very neat Greek letter. They ſeem to have had but *a very ſmall quantity* of Greek types in the monaſtery; for, in the firſt part of the work, whenever a long ſentence occurred, a blank was left, that it might be written in with a pen: after the middle of the work, however, all the Greek that occurs is printed.

The firſt printers who ſettled at Rome were Conrad Sweynheim and Arnold Pannartz, who introduced the preſent *Roman* type, in 1466, in Cicero's *Epiſtolæ Familiares:* in 1469 they printed a beautiful edition of *Aulus Gellius,* with the Greek quotations in a fair character, without accents or ſpirits, and with very few abbreviations.

The firſt whole book that is yet known is the Greek Grammar of Conſtantine Laſcaris, in quarto, reviſed by Demetrius Cretenſis, and printed by Dionyſius Palaviſinus, at Milan, 1476. In 1481, the Greek *Pſalter* was printed here, with a Latin tranſlation, in folio; as was Æſop's Fables in quarto.

Venice ſoon followed the example of Milan; and in 1486 were publiſhed in that city the *Greek Pſalter* and the *Batrachomyomachia,* the former by Alexander, and the latter by Laonicus, both natives of Crete. They were printed in a very uncommon character; the latter of them with *accents* and *ſpirits,* and alſo with *ſcholia.*

In 1488, however, all former publications in this language were eclipſed by a fine edition of *Homer's Works* at Florence, in folio, printed by Demetrius, a native of Crete. Thus printing (ſays Mr Maittaire, p. 185.) ſeems to have attained its ακμη of perfection, after having exhibited moſt beautiful ſpecimens of Latin, Greek, and Hebrew.

In 1493, a fine edition of *Iſocrates* was printed at Milan, in folio, by Henry German and Sebaſtian ex Pantremulo.

All the above works are prior in time to thoſe of Aldus, who has been erroneouſly ſuppoſed to be the *firſt* Greek printer: the beauty, however, correctneſs, and number of his editions, place him in a much higher rank than his predeceſſors; and his characters in general were more elegant than any before uſed. He was born in 1445, and died in 1515.

Though the noble Greek books of Aldus had raiſed an univerſal deſire of reviving that tongue, the French were backward in introducing it. The only pieces printed by them were ſome quotations, ſo wretchedly performed, that they were rather to be gueſſed at than read; in a character very rude and uncouth, and without accents. But Francis Tiſſard introduced the ſtudy of this language at Paris, by his Βιϐλος η γνωμαγυρικη, in 1507; and that branch of printing was afterwards ſucceſsfully practiſed by Henry, Robert, and Henry Stephens. See the article Stephens.

The earlieſt edition of the *whole Bible* was, ſtrictly ſpeaking, the Complutenſian Polyglott of Cardinal Ximenes; but as that edition, though finiſhed in 1517, was not publiſhed till 1522, the *Venetian* Septuagint of 1518 may properly be called the firſt edition of the *whole* Greek Bible; Eraſmus having publiſhed the New Teſtament *only* at Baſil in 1516.

16 Of the firſt Hebrew printing.

A very ſatisfactory account of Hebrew printing is thus given by Dr Kennicott in his *Annual Accounts of the Collation of Hebrew MSS.* p. 112. "The method which ſeems to have been originally obſerved in printing the Hebrew Bible was juſt what might have been expected: 1. The Pentateuch in 1482. 2. The Prior Prophets, in 1484. 3. The Poſterior Prophets, in 1486. 4. The Hagiographa, in 1487. And, after the four great parts had been thus printed ſeparately (each with a comment), the whole text (without a comment) was printed in one volume in 1488; and the text continued to be printed, as in theſe firſt editions, ſo in ſeveral others for 20 or 30 years, without Marginal *Keri* or *Maſora,* and with greater arguments to the more ancient MSS. till about the year 1520 ſome of the Jews adopted later MSS. and the *Maſora;* which abſurd preference has obtained ever ſince."

Thus much for the ancient editions given by Jews.

In 1642 a Hebrew Bible was printed at Mantua under the care of the moſt learned Jews in Italy. This Bible had not been heard of among the Chriſtians in this country, nor perhaps in any other; though the nature of it is very extraordinary. The text indeed is nearly the ſame with that in other modern editions; but at the bottom of each page are various readings, amounting in the whole to above 2000, and many of them of great conſequence, collected from manuſcripts, printed editions, copies of the Talmud, and the works of the moſt renowned Rabbies. And in one of the notes is this remark:—"That in ſeveral paſſages of the Hebrew Bible the differences are ſo many and ſo great, that they know not which to fix upon as the true readings."

We cannot quit the ſubject without obſerving, on Dr Kennicott's authority, that as the firſt printed Bibles are more correct than the latter ones; ſo the variations between the firſt edition, printed in 1488, and the edition of Vander Hooght, in 1705, at Amſterdam, in 2 vols 8vo, amount, upon the whole, to above 1200! See further *Bowyer and Nichols,* p. 112—117.

17 Anecdotes of early printing.

When the art of printing was firſt diſcovered, they only made uſe of one ſide of a leaf: they had not yet found out the expedient of impreſſing the other. When their editions were intended to be curious, they omitted to print the firſt letter of a chapter, for which they left a blank ſpace, that it might be painted or illuminated at the option of the purchaſer. Several ancient volumes of theſe early times have been found, where theſe letters are wanting, as they neglected to have them painted.

When the art of printing was firſt eſtabliſhed, it was the glory of the learned to be correctors of the preſs to the eminent printers. Phyſicians, lawyers, and biſhops themſelves, occupied this department. The printers then added frequently to their names thoſe of the correctors of the preſs; and editions were then valued according to the abilities of the corrector.

In the productions of early printing may be diſtinguiſhed the various ſplendid editions they made of *Primers* or *Prayer-books.* They were embelliſhed with cuts finiſhed in moſt elegant taſte: many of them were ludicrous, and ſeveral were obſcene. In one of them an angel is repreſented crowning the Virgin Mary, and God the Father himſelf aſſiſting at the ceremony. We have ſeen in a book of natural hiſtory the Supreme Being repreſented as *reading* on the ſeventh day, when he reſted from all his works. Sometimes St Michael is ſeen overcoming Satan; and ſometimes St Anthony appears attacked by various devils of moſt hideous forms. The *Prymer of Saliſbury,* 1533, is full of cuts: at the bottom of the title page there is the following remarkable prayer:

God be in my Bede,
  And in my Underſtandynge.
God be in my Eyen,
  And in my Lokynge.

God be in my Mouthe,
And in my Spekynge.
God be in my Herte,
And in my thinkinge.
God be at myn ende,
And at my departynge.

18 Method of printing. The workmen employed in the art of printing are of two kinds: compoſitors, who range and diſpoſe the letters into words, lines, pages, &c. according to the copy delivered them by the author; and preſſmen, who apply ink upon the ſame, and take off the impreſſion. The types being caſt, the compoſitor diſtributes each kind by itſelf among the diviſions of two wooden frames, an upper and an under one, called *caſes;* each of which is divided into little cells or boxes. Thoſe of the upper caſe are in number 98: theſe are all of the ſame ſize; and in them are diſpoſed the capitals, ſmall capitals, accented letters, figures, &c. the capitals being placed in alphabetical order. In the cells of the lower caſe, which are 54, are placed the ſmall letters, with the points, ſpaces, &c.. The boxes are here of different ſizes, the largeſt being for the letters moſt uſed; and theſe boxes are not in alphabitical order, but the cells which contain the letter ofteneſt wanted are neareſt the compoſitor's hand. Each caſe is placed a little aſlope, that the compoſitor may the more eaſily reach the upper boxes. Plate CCCCXV The inſtrument in which the letters are ſet is called a *compoſing-ſtick* (n° 1.), which conſiſts of a long and narrow plate of braſs or iron, &c. on the right ſide of which ariſes a ledge, which runs the whole length of the plate, and ſerves to ſuſtain the letters, the ſides of which are to reſt againſt it; along this ledge is a row of holes, which ſerve for introducing the ſcrew *a* in order to lengthen or ſhorten the extent of the line, by moving the ſliders *b c* farther from or nearer to the ſhorter ledge at the end *d*. Where marginal notes are required in a work, the two ſliding pieces *bc* are opened to a proper diſtance from each other in ſuch a manner as that while the diſtance between *dc* forms the length of the line in the text, the diſtance between the two ſliding-pieces forms the length of the lines for the notes on the ſide of the page. Before the compoſitor proceeds to compoſe, he puts a rule or thin ſlip of braſs-plate, cut to the length of the line, and of the ſame height as the letter, in the compoſing-ſtick, againſt the ledge, for the letter to bear againſt. Things thus prepared, the compoſitor having the copy lying before him, and his ſtick in his left hand, his thumb being over the ſlider *c;* with the right he takes up the letters, ſpaces, &c. one by one, and places them againſt the rule, while he ſupports them with his left thumb by preſſing them to the end of the ſlider *c*, the other hand being conſtantly employed in ſetting in other letters: the whole being performed with a degree of expedition and addreſs not eaſy to be imagined.

A little being thus compoſed, if it end with a word or ſyllable, and exactly fill the meaſure, there needs no further care; otherwiſe, more ſpaces are to be put in, or elſe the diſtance leſſened, between the ſeveral words, in order to make the meaſure quite full, ſo that every line may end even. The ſpaces here uſed are pieces of metal exactly ſhaped like the ſhanks of the letters: they are of various thickneſſes, and ſerve to ſupport the letters, and to preſerve a proper diſtance between the words; but not reaching ſo high as the letters, they make no impreſſion when the work is printed. The firſt line being thus finiſhed the compoſitor proceeds to the next; in order to which he moves the braſs-rule from behind the former, and places it before it, and thus compoſes another line againſt it after the ſame manner as before; going on thus till his ſtick is full, when he empties all the lines contained in it into the gally.

The compoſitor then fills and empties his compoſing-ſtick as before, till a complete page be formed; when he ties it up with a cord or pack-thread; and ſetting it by, proceeds to the next, till the number of pages to be contained in a ſheet is completed; which done, he carries them to the impoſing ſtone, there to be ranged in order, and faſtened together in a frame called a *chaſe;* and this is termed *impoſing*. The chaſe is a rectangular iron frame, of different dimenſions according to the ſize of the paper to be printed, having two croſs-pieces of the ſame metal, called a *long* and *ſhort croſs*, mortiſed at each end ſo as to be taken out occaſionally. By the different ſituations of theſe croſſes the chaſe is fitted for different volumes: for quartos and octavos, one traverſes the middle lengthwiſe, the other broadwiſe, ſo as to interſect each other in the centre: for twelves and twenty-fours, the ſhort croſs is ſhifted nearer to one end of the chaſe; for folios, the long croſs is left entirely out, and the ſhort one left in the middle; and for broadſides, both croſſes are ſet aſide. To dreſs the chaſe, or range and fix the pages therein, the compoſitor makes uſe of a ſet of furniture, conſiſting of ſlips of wood of different dimenſions, and about half an inch high, that they may be lower than the letters: ſome of theſe are placed at the top of the pages, and called *head-ſticks;* others between them, to form the inner margin; others on the ſides of the croſſes, to form the outer margin, where the paper is to be doubled; and others in the form of wedges to the ſides and bottoms of the pages. Thus all the pages being placed at their proper diſtances, and ſecured from being injured by the chaſe and furniture placed about them, they are all untied, and faſtened together by driving ſmall pieces of wood called *quoins*, cut in the wedge-form, up between the ſlanting ſide of the foot and the ſide ſticks and the chaſe, by means of a piece of hard wood and a mallet; and all being thus bound faſt together, ſo that none of the letters will fall out, it is ready to be committed to the preſſmen. In this condition the work is called a *form;* and as there are two of theſe forms required for every ſheet, when both ſides are to be printed, is is neceſſary the diſtances between the pages in each form ſhould be placed with ſuch exactneſs, that the impreſſion of the pages in one form ſhall fall exactly on the back of the pages of the other, which is called *regiſter*.

As it is impoſſible but that there muſt be ſome miſtakes in the work, either through the overſight of the compoſitor, or by the caſual tranſpoſition of letters in the caſes; a ſheet is printed off, which is called a *proof*, and given to the corrector; who reading it over, and rectifying it by the copy, making the alterations in the margin, it is delivered back to the compoſitor to be corrected.

The compoſitor then unlocking the form upon the correcting-ſtone, by looſening the quoins or wedges which bound the letters together, rectifies the miſtakes by picking out the faulty or wrong letters with a ſlender ſharp-pointed ſteel-bodkin, and putting others into their places. After this another proof is made, ſent to the author, and corrected as before; and laſtly, there is another proof called a *reviſe*, which is made in order to ſee whether all the miſtakes marked in the laſt proof are corrected.

The preſſman's buſineſs is to work off the forms thus prepared and corrected by the compoſitor; in doing which there are four things required, paper, ink, balls, and a preſs. To prepare the paper for uſe, it is to be firſt wetted by dipping ſeveral ſheets together in water: theſe are afterwards laid in a heap over each other; and to make them take the water equally, they are all preſſed cloſe down with a weight at the top. The ink is made of oil and lamp-black; for the manner of preparing which, ſee *Printing-Ink*. The balls, by which the ink is applied on the forms, are a kind of wooden funnels with handles, the cavities of which are filled with wool or hair, as is alſo a piece of alum leather or pelt nailed over the cavity, and made extremely ſoft by ſoaking in urine and by being well rubbed. One of theſe the preſſman takes in each hand; and applying one of them to the ink-block, daubs and works them together to diſtribute the ink equally; and then blackens the form which is placed on the preſs, by beating with the balls upon the face of the letter.

Plate CCCCXV. The printing-preſs, repreſented n° 2. is a very curious though complex machine. The body conſiſts of two ſtrong cheeks *a a*, placed perpendicularly, and joined together by four croſs-pieces; the cap *b;* the head *c*, which is moveable, being partly ſuſtained by two iron pins or long bolts, that paſs the cap; the till or ſhelf *d d*, by which the ſpindle and its apparatus are kept in their proper poſition; and the winter *e*, which bears the carriage, and ſuſtains the effort of the preſs beneath. The ſpindle *f* is an upright piece of iron pointed with ſteel, having a male ſcrew which goes into the female one in the head about four inches. Through the eye *g* of this ſpindle is faſtened the bar *k*, by which the preſſman makes the impreſſion. The ſpindle paſſes through a hole in the middle of the till; and its point works into a braſs pan or nut, ſupplied with oil, which is fixed to an iron plate let into the top of the platten. The body of the ſpindle is ſuſtained in the centre of an open frame of poliſhed iron, 1, 1, 2, 2. 3, 3, fixed to it in ſuch a manner as, without obſtructing its free play, to keep it in a ſteady direction; and at the ſame time to ſerve for ſuſpending the platten. This frame conſiſts of two parts; the upper called the *garter*, 1, 1; the under, called the *crane*, 2, 2. Theſe are connected together by two ſhort legs or bolts, 3, 3; which being fixed below in the two ends of the crane, paſs upward, through two holes in the till, and are received at top into two eyes at the ends of the garter, where they are ſecured by ſcrews. The carriage *l l* is placed a foot below the platten, having its fore-part ſupported by a prop called the *fore-ſtay*, while the other reſts on the winter. On this carriage, which ſuſtains the plank, are nailed two long iron bars or ribs; and on the plank are nailed ſhort pieces of iron or ſteel called *cramp-irons*, equally tempered with the ribs, and which ſlide upon them when the plank is turned in or out. Under the carriage is fixed a long piece of iron called the *ſpit*, with a double wheel in the middle, round which leather-girts are faſtened, nailed to each end of the plank: and to the outſide of the ſpit is fixed a rounce *m*, or handle to turn round the wheel. Upon the plank is a ſquare frame or coffin, in which is incloſed a poliſhed ſtone on which the form *n* is laid; at the end of the coffin are three frames, *viz.* the two tympans and friſket: the tympans *o* are ſquare, and made of three ſlips of very thin wood, and at the top a piece of iron ſtill thinner; that called the *outer tympan* is faſtened with hinges to the coffin: they are both covered with parchment; and between the two are placed blankets, which are neceſſary to take off the impreſſion of the letters upon the paper. The friſket *p* is a ſquare frame of thin iron, faſtened with hinges to the tympan: it is covered with paper cut in the neceſſary places, that the ſheet, which is put between the friſket and the great or outward tympan, may receive the ink, and that nothing may hurt the margins. To regulate the margins, a ſheet of paper is faſtened upon this tympan, which is called the *tympan ſheet;* and on each ſide is fixed an iron point, which makes two holes in the ſheet, which is to be placed on the ſame points when the impreſſion is to be made on the other ſide. In preparing the preſs for working, the parchment which covers the outer tympan is wetted till it is very ſoft, in order to render the impreſſion more equable; the blankets are then put in, and ſecured from ſlipping by the inner tympan: then while one preſſman is beating the letter with the balls *q*, covered with ink taken from the ink-block, the other perſon places a ſheet of white paper on the tympan-ſheet; turns down the friſket upon it, to keep the paper clean and prevent its ſlipping; then bringing the tympans upon the form, and turning the rounce, he brings the form with the ſtone, &c. weighing about 300 lbs. weight, under the platten; pulls with the bar, by which means the platten preſſes the blankets and paper cloſe upon the letter, whereby half the form is printed; then eaſing the bar, he draws the form ſtill forward; gives a ſecond pull; and letting go the bar, turns back the form, takes up the tympans and friſket, takes out the printed ſheet, and lays on a freſh one; and this is repeated till he has taken off the impreſſion upon the full number of ſheets the edition is to conſiſt of. One ſide of the ſheet being thus printed, the form for the other is laid upon the preſs, and worked off in the ſame manner.

Chineſe Printing, is performed from wooden planks or blocks, cut like thoſe uſed in printing of callico, paper, cards, &c.

Rolling-preſs Printing, is employed in taking off prints or impreſſions from copperplates engraven, etched, or ſcraped, as in mezzotintos. See Engraving.

This art is ſaid to have been as ancient as the year 1540, and to owe its origin to Finiguerra, a Florentine goldſmith, who pouring ſome melted brimſtone on an engraven plate, found the exact impreſſion of the engraving left in the cold brimſtone, marked with black taken out of the ſtrokes by the liquid ſulphur: upon this he attempted to do the ſame on ſilver plates with wet paper, by rolling it ſmoothly with a roller; and this ſucceeded: but this art was not uſed in England till the reign of king James I. when it was brought from Antwerp by Speed. The form of the rolling preſs, the compoſition of the ink uſed therein, and the manner of applying both in taking off prints, are as follow:

Plate CCCCXV.

The rolling-preſs AL, n° 3. may be divided into two parts, the body and carriage: the body conſiſts of two wooden cheeks PP, placed perpendicularly on a ſtand or foot LM, which ſuſtains the whole preſs. From the foot likewiſe are four other perpendicular pieces *c, c, c, c*, joined by other croſs or horizontal ones *d, d, d*, which ſerve to ſuſtain a ſmooth even plank or table HIK, about four feet and a half long, two feet and a half broad, and an inch and a half thick. Into the cheeks go two wooden cylinders or rollers, DE, FG, about ſix inches in diameter, borne up at each end by the cheeks, whoſe ends, which are leſſened to about two inches diameter, and called *trunnions*, turn in the cheeks about two pieces of wood in form of half-moons, lined with poliſhed iron to facilitate the motion. Laſtly, to one of the trunnions of the upper roller is faſtened a croſs, conſiſting of two levers AB, or pieces of wood, traverſing each other, the arms of which croſs ſerve inſtead of the bar or handle of the letter-preſs, by turning the upper roller, and when the plank is between the two rollers, giving the ſame motion to the under one, by drawing the plank forward and backward.

The ink uſed for copperplates, is a compoſition made of the ſtones of peaches and apricots, the bones of ſheep and ivory, all well burnt, and called *Frankfort black*, mixed with nut-oil that has been well boiled, and ground together on a marble, after the ſame manner as painters do their colours.

The method of printing from copperplates is as follows: They take a ſmall quantity of this ink on a rubber made of linen-rags, ſtrongly bound about each other, and therewith ſmear the whole face of the plate as it lies on a grate over a charcoal fire. The plate being ſufficiently inked, they firſt wipe it over with a foul rag, then with the palm of their left hand, and then with that of the right; and to dry the hand and forward the wiping, they rub it from time to time in whiting. In wiping the plate perfectly clean, yet without taking the ink out of the engraving, the addreſs of the workman conſiſts. The plate thus prepared, is laid on the plank of the preſs; over the plate is laid the paper, firſt well moiſtened, to receive the impreſſion; and over the paper two or three folds of flannel. Things thus diſpoſed, the arms of the croſs are pulled, and by that means the plate with its furniture paſſed through between the rollers, which pinching very ſtrongly, yet equally, preſſes the moiſtened paper into the ſtrokes of the engraving, whence it licks out the ink.

PRINTS, the impreſſions taken from a copperplate. See the laſt article, and ENGRAVING.

Strutt's Dict. of Engravers.

From the facility of being multiplied, prints have derived an advantage over paintings by no means inconſiderable. They are found to be more durable; which may, however, in ſome degree be attributed to the different methods in which they are preſerved. Many of the beſt paintings of the early maſters have generally had the misfortune to be either painted on walls, or depoſited in large and unfrequented, and conſequently damp and deſtructive, buildings; whilſt a print, paſſing, at diſtant intervals, from the *porte feuille* of one collector to that of another, is preſerved without any great exertion of its owner: And hence it happens, that whilſt the pictures of Raphael have mouldered from their walls, or deſerted their canvas, the prints of his friend and cotemporary Mark Antonio Raimondi continue in full perfection to this day, and give us a lively idea of the beauties of thoſe paintings, which, without their aſſiſtance, had been loſt to us for ever; or at leaſt, could have been only known to us, like thoſe of Zeuxis and Apelles, by the deſcriptions which former writers on theſe ſubjects have left us.

Independent of the advantages which prints afford us, when conſidered as accurate repreſentations of paintings, and imitations of ſuperior productions, they are no leſs valuable for their poſitive merit, as immediate repreſentations of nature. For it muſt be recollected, that the art of engraving has not always been confined to the copying other productions, but has frequently itſelf aſpired to originality, and has, in this light, produced more inſtances of its excellence than in the other. Albert Durer, Goltzius, and Rembrant, amongſt the Dutch and Germans; Parmigiano and Della Bella amongſt the Italians, and Callot amongſt the French, have publiſhed many prints, the ſubjects of which, there is great reaſon to ſuppoſe, were never painted. Theſe prints may therefore be conſidered as original pictures of thoſe maſters, deficient only in thoſe particulars in which a print muſt neceſſarily be inferior to a painting.

The preceding diſtinction may perhaps throw ſome light on the proper method of arranging and claſſing a collection of prints, which has been a matter of no ſmall difficulty. As an art imitating another, the principal ſhould take the lead, and the deſign, compoſition, and drawing, in a print, being previous requiſites to the manner of execution and finiſhing; prints engraved after paintings ſhould be arranged under the name of the painter; and every perſon who looks upon engraving only as auxiliary to painting, will conſequently adopt this mode of arrangement. But when engraving is conſidered as an original art, as imitating nature without the intervention of other methods, then it will certainly be proper to regulate the arrangement according to the names of the engravers.

PRIOR, in general, ſomething before or nearer the beginning than another, to which it is compared.

PRIOR, more particularly denotes the ſuperior of a convent of monks, or the next under the abbot. See ABBOT.

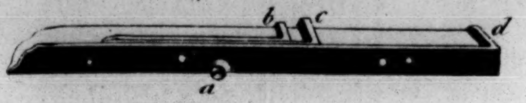
Priors are either *clauſtral* or *conventual*. *Conventual* are the ſame as abbots. *Clauſtral* prior, is he who governs the religious of an abbey or priory *in commendam*, having his juriſdiction wholly from the abbot.

Grant PRIOR, is the ſuperior of a large abbey, where ſeveral ſuperiors are required.

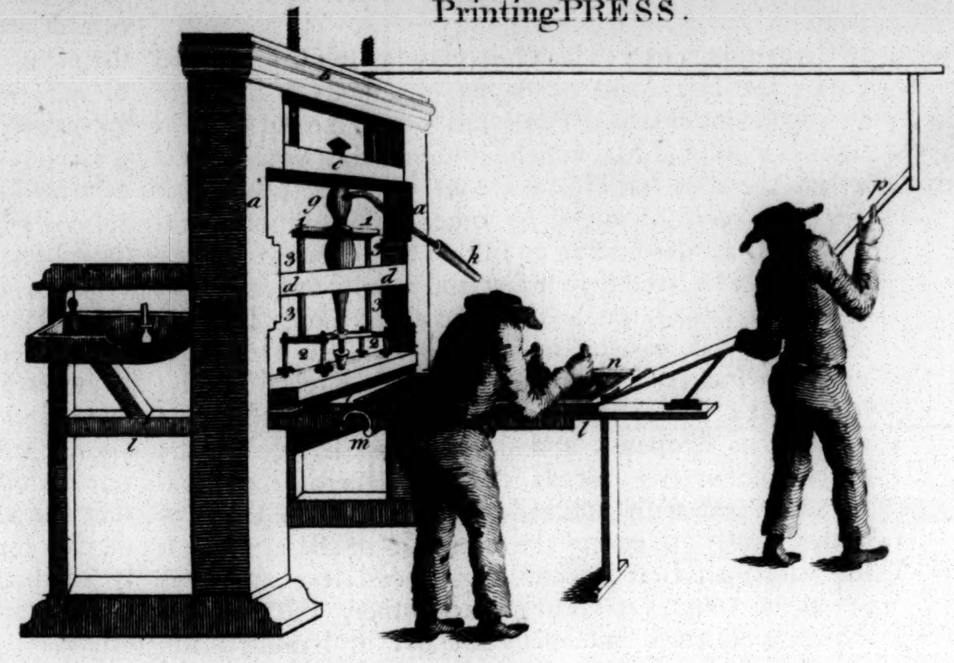
PRIOR (Matthew), an eminent Engliſh poet, was born at London in 1664. His father dying while he was very young, an uncle a vintner, having given him ſome education at Weſtminſter ſchool, took him home in order to breed him up to his trade. However, at his leiſure hours he proſecuted his ſtudy of the claſſics, and eſpecially of his favourite Horace. This in-

Plate CCCCXV.

Composing Stick.



Printing PRESS.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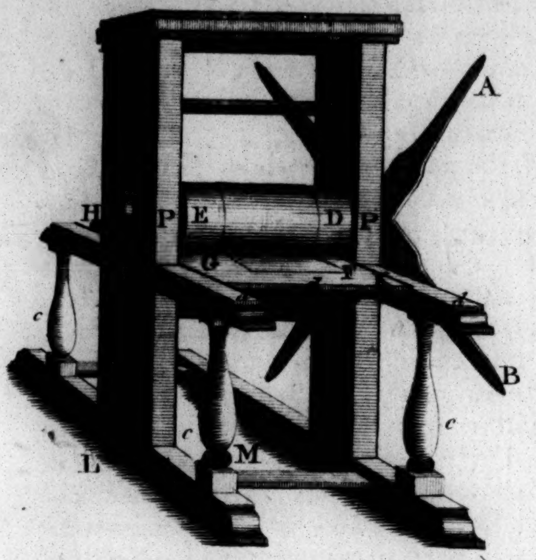
Rolling PRESS.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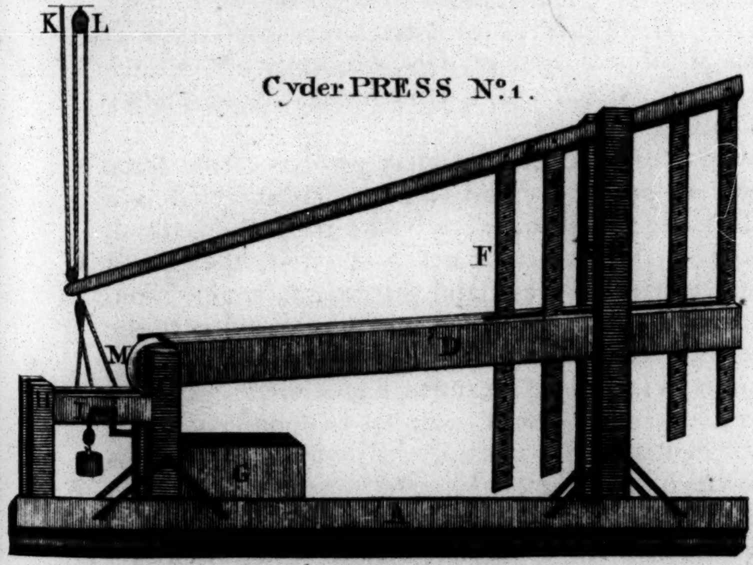
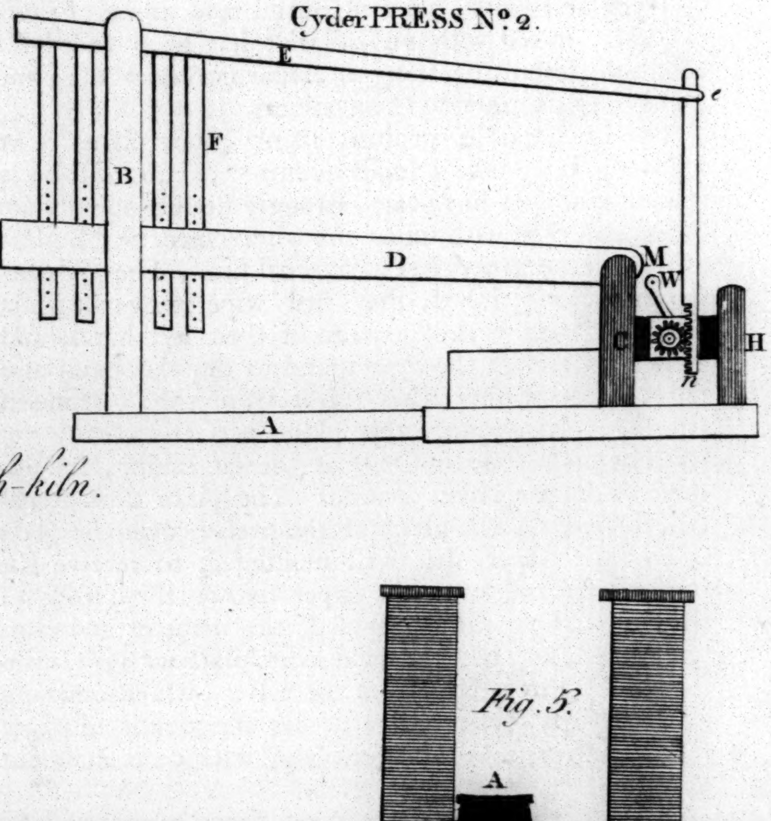
Cyder PRESS N°. 1.



Cyder PRESS N°. 2.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Potash-kiln.

Fig. 1.

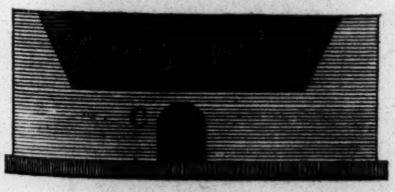


Fig. 4.

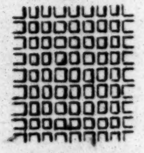


Fig. 2.

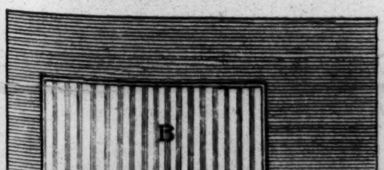


Fig. 3.

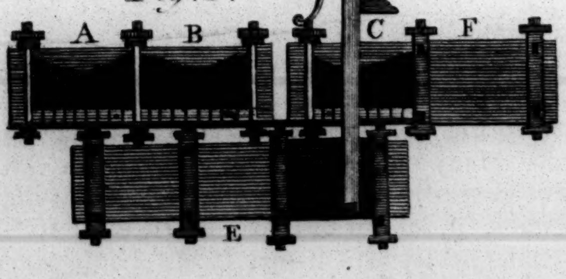
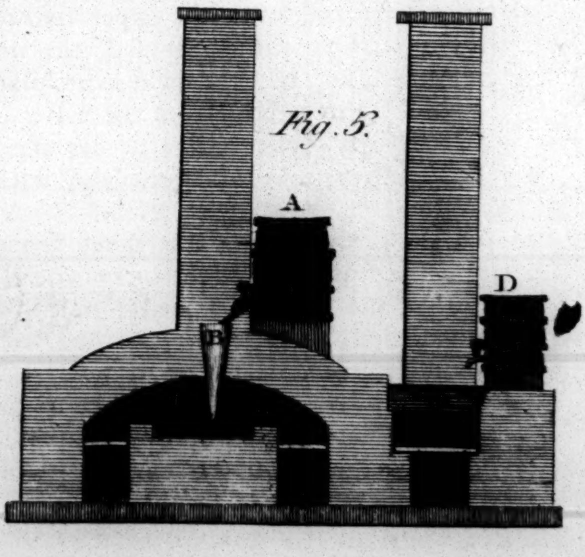


Fig. 5.



F. Shallus sc. Phil^a.

BRITISH MUSEUM

troduced him to ſome polite company, who frequented his uncle's houſe; among whom the earl of Dorſet took particular notice of him, and procured him to be ſent to St John's college in Cambridge, where, in 1686, he took the degree of A. B. and afterwards became fellow of that college. Upon the revolution, Mr Prior was brought to court by the earl of Dorſet; and in 1690 he was made ſecretary to the earl of Berkeley, plenipotentiary at the Hague; as he was afterward to the ambaſſador and plenipotentiaries at the treaty of Ryſwick in 1697; and the year following to the earl of Portland, ambaſſador to the court of France. He was in 1697 made ſecretary of ſtate for Ireland; and in 1700 was appointed one of the lords commiſſioners of trade and plantations. In 1710, he was ſuppoſed to have had a ſhare in writing *The Examiner*. In 1711, he was made one of the commiſſioners of the cuſtoms; and was ſent miniſter plenipotentiary to France, for the negociating a peace with that kingdom. Soon after the acceſſion of George I. to the throne in 1714, he preſented a memorial to the court of France, requiring the demoliſhing of the canal and new works at Mardyke. The year following he was recalled; and upon his arrival was taken up by a warrant from the houſe of commons, and ſtrictly examined by a committe of the privy-council. Robert Walpole, Eſq; moved the houſe of commons for an impeachment againſt him; and Mr Prior was ordered into cloſe cuſtody. In 1717, he was excepted out of the act of grace; however, at the cloſe of that year, he was ſet at liberty. The remainder of his days he ſpent in tranquillity and retirement; and died in 1721. His poems are well known, and juſtly admired. He is ſaid to have written the following epitaph for himſelf:

"Nobles and heralds, by your leave,
Here lie the bones of Matthew Prior,
The ſon of Adam and of Eve:
Let Bourbon or Naſſau go higher."

Alien PRIORIES, were cells of the religious houſes in England which belonged to foreign monaſteries: for when manors or tithes were given to foreign convents, the monks, either, to increaſe their own rule, or rather to have faithful ſtewards of their revenues, built a ſmall convent there for the reception of ſuch a number as they thought proper, and conſtituted priors over them.—Within theſe cells there was the ſame diſtinction as in thoſe priories which were cells ſubordinate to ſome great abbey; ſome of theſe were conventual, and, having priors of their own chooſing, thereby became entire ſocieties within themſelves, and received the revenues belonging to their ſeveral houſes for their own uſe and benefit, paying only the ancient apport (A), acknowledgment, or obvention, at firſt the ſurpluſage, to the foreign houſe; but others depended entirely on the foreign houſes, who appointed and removed their priors at pleaſure. Theſe tranſmitted all their revenues to the foreign head houſes; for which reaſon their eſtates were generally ſeized to carry on the wars between England and France, and reſtored to them again on return of peace. Theſe alien priories were moſt of them founded by ſuch as had foreign abbeys founded by themſelves or by ſome of their family.

The whole number is not exactly aſcertained: the Monaſticon hath given a liſt of 100: Weever, p. 338. ſays 110.

Some of theſe cells were made indigenous or denizon, or endenized. The alien priories were firſt ſeized by Edward I. 1285, on the breaking out of the war between France and England; and it appears from a roll, that Edward II. alſo ſeized them, though this is not mentioned by our hiſtorians; and to theſe the act of reſtitution 1 Ed. III. ſeems to refer.

In 1337, Edward III, confiſcated their eſtates, and let out the priories themſelves with all their lands and tenements, at his pleaſure, for 23 years; at the end of which term, peace being concluded between the two nations, he reſtored their eſtates 1361, as appears by his letters patent to that of Montacute, county of Somerſet, printed at large in Rymer, vol. vi. p. 311. and tranſlated in Weever's *Funeral Monuments*, p. 339. At other times he granted their lands, or lay penſions out of them, to divers noblemen. They were alſo ſequeſtered during Richard II.'s reign, and the head monaſteries abroad had the king's licence to ſell their lands to other religious houſes or to any particular perſons who wanted to endow others.

Henry IV. began his reign with ſhowing ſome favour to the alien priories, reſtoring all the conventual ones, only reſerving to himſelf in time of war what they paid in time of peace to the foreign abbeys.

They were all diſſolved by act of parliament 2 Henry V. and all their eſtates veſted in the crown, except ſome lands granted to the college of Fotheringhay. The act of diſſolution is not printed in the ſtatute books, but it is to be found entire in Rymer's *Fædera*, IX. 283. and in the Parliament Rolls, vol. iv. p. 22. In general, theſe lands were appropriated to religious uſes. Henry VI. endowed his foundations at Eton in Cambridge with the lands of the alien priories, in purſuance of his father's deſign to appropriate them all to a noble college at Oxford. Others were granted in fee to the prelates, nobility, or private perſons. Such as remained in the crown were granted by Henry VI. 1440, to archbiſhop Chichley, &c. and they became part of his and the royal foundations. See *Some Account of Alien-priories*, &c. in two volumes octavo.

PRIORITY, the relation of ſomething conſidered as prior to another.

PRIORITY, in law, denotes an antiquity of tenure, in compariſon of another leſs ancient.

PRISCIANUS, an eminent grammarian, born at Cæſarea, taught at Conſtantinople with great reputation about the year 525. Laurentius Valla calls Priſcian, Donatus, and Servius, *triumviri in re grammatica*; and thinks none of the ancients who wrote after them fit to be mentioned with them. He compoſed a work *De arte grammatica*, which was firſt printed by Aldus at

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(A) *Apportus* or *apportagium* (from *portare*), an acknowledgment, oblation, or obvention, to the mother houſe or church. *Du Cange*.

at Venice in 1476; and another *De naturalibus quæſtionibus*, which he dedicated to Choſroes king of Perſia: beſide which, he tranſlated Dionyſius's deſcription of the world into Latin verſe. A perſon who writes falſe Latin, is proverbially ſaid to "break Priſcian's head."

PRISCILLIANISTS, in church-hiſtory, Chriſtian heretics, ſo called from their leader Priſcillian, a Spaniard by birth, and biſhop of Avila. He is ſaid to have practiſed magic, and to have maintained the principal errors of the Manichees; but his peculiar tenet was, That it is lawful to make falſe oaths in order to ſupport one's cauſe and intereſt.

PRISM, an oblong ſolid, contained under more than four planes, whoſe baſes are equal, parallel, and alike ſituated. See OPTICS, nº 142.

PRISON, a goal, or place of confinement.

Lord Coke obſerves, that a priſon is only a place of ſafe cuſtody, *ſalva cuſtodia*, not a place of puniſhment. If this be ſo, and it cannot be queſtioned, priſons ought not to be, what they are in moſt parts of Europe, loathſome dungeons. Any place where a perſon is confined may be ſaid to be a priſon; and when a proceſs is iſſued againſt one, he muſt, when arreſted thereon, either be committed to priſon, or be bound in a recognizance with ſureties, or elſe give bail, according to the nature of the caſe, to appear at a certain day in court, there to make anſwer to what is alledged againſt him. Where a perſon is taken and ſent to priſon, in a civil caſe, he may be releaſed by the plaintiff in the ſuit; but if it be for treaſon or felony, he may not regularly be diſcharged, until he is indicted of the fact and acquitted. See INDICTMENT, and the next article.

PRISONER, a perſon reſtrained or kept in priſon upon an action civil or criminal, or upon commandment: and one may be a priſoner on matter of record, or matter of fact. A priſoner upon matter of record, is he who, being preſent in court, is by the court committed to priſon; and the other is one carried to priſon upon an arreſt, whether it be by the ſheriff, conſtable or other officer.

PRISTIS, the SAWFISH, is generally conſidered as a ſpecies of the *ſqualus* or *ſhark* genus, comprehending under it ſeveral varieties. Mr Latham, however, is of opinion that it ought to be conſidered as a diſtinct genus itſelf, and that the characteriſtics of the ſeveral varieties are ſufficient to conſtitute them diſtinct ſpecies. According to him therefore the *priſtis* is a genus belonging to the order of *amphibia nantes*; and its characters are as follow: A long plane beak or ſnout, with ſpines growing like teeth out of both edges; four or five *ſpiracula*, or breathing apertures, in the ſides of the neck: the body is oblong and almoſt round, with a rough coriaceous ſkin; the mouth is ſituated in the lower part of the head; and the noſtrils, before the mouth, are half covered with a membranaceous lobe; behind the eys are two oval holes; the ventral fins approach one another, and in the male are placed about the organs of generation; there are no fins at the anus. Of this genus our author enumerates five ſpecies.

1. *Priſtus antiquorum*. The head is rather flat at top; the eyes large, with yellow irides; behind each is a hole, which ſome have ſuppoſed may lead to an organ of hearing. The mouth is well furniſhed with teeth, but they are blunt, ſerving rather to bruiſe its prey than to divide it by cutting. Before the mouth are two foramina, ſuppoſed to be the noſtrils. The *roſtrum*, beak, or ſnout, is in general about one-third of the total length of the fiſh, and contains in ſome 18, in others as far as 23 or 24 ſpines on each ſide; theſe are very ſtout, much thicker at the back-part, and channelled, inclining to an edge forwards. The fins are ſeven in number—viz. two dorſal, placed at ſome diſtance from each other—two pectoral, taking riſe juſt behind the breathing-holes, which are five in number—two ventral, ſituated almoſt underneath the firſt dorſal—and laſtly the caudal, occupying the tail both above and beneath, but longeſt on the upper part. The general colour of the body is a dull grey, or browniſh, growing paler as it approaches the belly, where it is nearly white. 2. *Pectinatus*, which, with the former ſpecies, grows to the largeſt ſize of any that have yet come under the inſpection of the naturaliſt, ſome ſpecimens meaſuring 15 feet in length. The pectinatus differs from the priſtis antiquorum, in having the ſnout more narrow in proportion at the baſe, and the whole of it more ſlender in all its parts; whereas the firſt is very broad at the baſe, and tapers conſiderably from thence to the point. The ſpines on each ſide alſo are longer and more ſlender, and vary from 25 to 34 in the different ſpecimens: we have indeed been informed of one which contained no leſs than 36 ſpines on each ſide of the ſnout; but we muſt confeſs that we have never been fortunate enough to have ſeen ſuch a ſpecimen. 3. *Cuſpidatus*, of which our author has ſeen only two ſpecimens, the one about a foot and a half in length, and the other more than two feet and a half. In both of theſe were 28 ſpines on each ſide; but the diſtinguiſhing feature is in the ſpines themſelves, being particularly flat and broad, and ſhaped at the point more like the lancet uſed by ſurgeons in bleeding, than any other figure. We believe that no other author has hitherto taken notice of this ſpecies. 4. *Microdon*, of which the total length is 28 inches, the ſnout occupying 10; from the baſe of this to that of the pectoral fins four inches; between the pectoral and ventral fins ſix. The two dorſal fins occupy nearly the ſame proportions in reſpect to each other; but the hinder one is the ſmalleſt, and all of them are greatly hollowed out at the back-part, much more ſo than in the two firſt ſpecies. The ſnout differs from that of every other, in ſeveral particulars: it is longer in proportion, being more than one-third of the whole fiſh. The ſpines do not ſtand out from the ſides more than a quarter of an inch, and from this circumſtance ſeem far leſs capable of doing injury than any other ſpecies yet known. 5. *Cirratus*, of which, continues our author, we have only met with one ſpecimen, which was brought from Port Jackſon in New Holland. It is a male, and the total length about 40 inches: the ſnout, from the tip of it to the eye, 11: the ſpines widely different from any of the others; they are indeed placed, as uſual, on the edge, but are continued on each ſide even beyond the eyes. The longer ones are ſlender, ſharp, ſomewhat bent, and about 20 in number; and between theſe are others not half the length of the primal ones, between ſome three or four, between others as far as ſix; and in general the middle one of theſe ſmaller ſeries is the longeſt: beſide theſe a

ſeries of minute ones may be perceived beneath, at the very edge. In the ſnout likewiſe another ſingularity occurs:—about the middle of it, on each ſide, near the edge, ariſes a flexible, ligamentous cord, about three inches and a half in length, appearing not unlike the beards at the mouth of ſome of the gadus or cod genus, and no doubt as pliant in the recent ſtate. The colour of the fiſh is a pale brown: the breathing apertures four in number: the mouth furniſhed with five rows of minute, but very ſharp teeth. See Plate CCCCXVI. where the ſnout marked 1 is that of the priſtis antiquorum; that marked 2, of pectinatus; and that marked 4, of microdon: the entire fiſh is the cirratus.

PRIVATEERS, are a kind of private men of war, the perſons concerned wherein adminiſter at their own coſts a part of a war, by fitting out theſe ſhips of force, and providing them with all military ſtores; and they have, inſtead of pay, leave to keep what they take from the enemy, allowing the admiral his ſhare, &c.

Privateers may not attempt any thing againſt the laws of nations; as to aſſault an enemy in a port or haven, under the protection of any prince or republic, whether he be friend, ally, or neuter; for the peace of ſuch places muſt be inviolably kept: therefore, by a treaty made by King William and the States of Holland, before a commiſſion ſhall be granted to any privateer, the commander is to give ſecurity, if the ſhip be not above 150 tons, in L. 1500, and if the ſhip exceeds that burden, in L. 3000, that they will make ſatisfaction for all damages which they ſhall commit in their courſes at ſea, contrary to the treaties with that ſtate, on pain of forfeiting their commiſſions; and the ſhip is made liable.

Jacob's Law Dict.

Beſides theſe private commiſſions, there are ſpecial commiſſions for privateers, granted to commanders of ſhips, &c. who take pay; who are under a marine diſcipline; and if they do not obey their orders, may be puniſhed with death: and the wars in later ages have given occaſion to princes to iſſue theſe commiſſions, to annoy the enemies in their commerce, and hinder ſuch ſupplies as might ſtrengthen them or lengthen out the war; and likewiſe to prevent the ſeparation of ſhips of greater force from their fleets or ſquadrons.

Ships taken by Britiſh privateers were to be divided into five parts; four parts whereof to go to the perſons intereſted in the privateer, and the fifth to his Majeſty: and as a farther encouragement, privateers, &c. deſtroying any French man of war or privateer, ſhall receive, for every piece of ordnance in the ſhip ſo taken, L. 10 reward, &c.

By a particular ſtatute lately made, the lord admiral, or commiſſioners of the admiralty, may grant commiſſions to commanders of privateers, for taking ſhips, &c. which being adjudged prize, and the tenth part paid to the admiral, &c. wholly belong to the owners of the privateers and the captors, in proportions agreed on between themſelves.

PRIVATION, in a general ſenſe, denotes the abſence or want of ſomething; in which ſenſe darkneſs is only the privation of light.

PRIVATIVE, in grammar, a particle, which, prefixed to a word, changes it into a contrary ſenſe. Thus, among the Greeks, the α is uſed as a primitive; as in α-θεος, *atheiſt*, *acephalus*, &c.——The Latins have their privitive *in*; as *incorrigibilis*, *indeclinabilis*, &c.——The Engliſh, French, &c. on occaſion borrow both the Latin and Greek privatives.

PRIVERNUM, (Livy, Virgil); a town of the Volſci, in Latium, to the eaſt of Setia. *Privernates*, the people. Whoſe ambaſſadors being aſked, What puniſhment they deſerved for their revolt? anſwered, What thoſe deſerve who deem themſelves worthy of liberty. And again, being aſked by the Roman conſul, ſhould the puniſhment be remitted, What peace was to be expected with them? If you grant a good peace, you may hope to have it ſincere and laſting; but if a bad one, you may well expect it of ſhort continuance. At which anſwer, the Romans were ſo far from being diſpleaſed, that by a vote of the people they had the freedom of the city granted them. *Privernas, atis*, the epithet. The town is now called *Piperno Vecchio*, ſituated in the Campania of Rome. E. Long. 10. 0. N. Lat. 41. 30.

PRIVET, in botany. See LIGUSTRUM.

PRIVILEGE, in law, ſome peculiar benefit granted to certain perſons or places, contrary to the uſual courſe of the law.

Privileges are ſaid to be *perſonal* or *real*.

Perſonal privileges are ſuch as are extended to peers, ambaſſadors, members of parliament, and of the convocation, &c. See LORDS, AMBASSADOR, PARLIAMENT, ARREST, &c.

A *real* privilege is that granted to ſome particular place; as the king's palace, the courts at Weſtminſter, the univerſities, &c.

PRIVILEGES of the Clergy. See CLERGY.

PRIVY, in law, is a partaker, or perſon having an intereſt, in any action or thing. In this ſenſe they ſay, privies in blood: every heir in tail is privy to recover the land intailed. In old law-books, merchants privy are oppoſed to merchants ſtrangers. Coke mentions four kinds of privies. Privies in blood, as the heir to his father; privies in repreſentation, as executors and adminiſtrators to the deceaſed; privies in eſtate, as he in reverſion, and he in remainder; donor and donee; leſſor and leſſee: laſtly, privy in tenure, as the lord by eſcheat; *i. e.* when land eſcheats to the lord for want of heirs.

PRIVY-Council. See COUNCIL. The king's will is the ſole conſtituent of a privy-counſellor; and it alſo regulates their number, which in ancient times was about twelve. Afterwards it increaſed to ſo large a number, that it was found inconvenient for ſecrecy and diſpatch; and therefore Charles II. in 1679, limited it to 30; whereof 15 were principal officers of ſtate, and to be counſellors *ex officio*; and the other 15 were compoſed of 10 lords and five commoners of the king's chooſing. Since that time however the number has been much augmented, and now continues indefinite. At the ſame time alſo, the ancient office of lord preſident of the council was revived, in the perſon of Anthony earl of Shafteſbury. Privy-counſellors are made by the king's nomination, without either patent or grant; and, on taking the neceſſary oaths, they become immediately privy-counſellors during the life of the king that chooſes them, but ſubject to removal at his diſcretion.

Privy.

Privy ‖ Proa.

Any natural born ſubject of England is capable of being a member of the privy-council; taking the proper oaths for ſecurity of the government, and the teſt for ſecurity of the church. By the act of ſettlement, 12 and 13 W. III. cap. 2. it is enacted, that no perſon born out of the dominions of the crown of England, unleſs born of Engliſh parents, even though naturalized by parliament, ſhall be capable of being of the privy-council. The duty of a privy-counſellor appears from the oath of office, which conſiſts of ſeven articles. 1. To adviſe the king according to the beſt of his cunning and diſcretion. 2. To adviſe for the king's honour and good of the public, without partiality, through affection, love, meed, doubt, or dread. 3. To keep the king's counſel ſecret. 4. To avoid corruption. 5. To help and ſtrengthen the execution of what ſhall be there reſolved. 6. To withſtand all perſons who would attempt the contrary. And, laſtly, in general, 7. To obſerve, keep, and do all that a good and true counſellor ought to do to his ſovereign lord.

The privy-council is the *primum mobile* of the ſtate, and that which gives the motion and direction to all the inferior parts. It is likewiſe a court of juſtice of great antiquity; the primitive and ordinary way of government in England being by the king and privy-council. It has been frequently uſed by all their kings for determining controverſies of great importance: the ordinary judges have ſometimes declined giving judgment till they had conſulted the king and privy-council; and the parliament have frequently referred matters of high moment to the ſame, as being by long experience better able to judge of, and, by their ſecrecy and expedition, to tranſact ſome ſtate affairs, than the lords and commons. At preſent, the privy-council takes cognizance of few or no matters except ſuch as cannot well be determined by the known laws and ordinary courts; ſuch as matters of complaint and ſudden emergencies: their conſtant buſineſs being to conſult for the public good in affairs of ſtate. This power of the privy-council is to inquire into all offences againſt the government, and to commit the offenders to ſafe cuſtody, in order to take their trial in ſome of the courts of law. But their juriſdiction herein is only to inquire, and not to puniſh; and the perſons committed by them are intitled to their *habeas corpus* by ſtatute 16 Car. I. cap. 10. as much as if committed by an ordinary juſtice of the peace.

In plantation or admiralty cauſes, which ariſe out of the juriſdiction of the kingdom, and in matters of lunacy and idiocy, the privy-council has cognizance, even in queſtions of extenſive property, being the court of appeal in ſuch cauſes; or, rather, the appeal lies to the king's majeſty himſelf in council. From all the dominions of the crown, excepting Great Britain and Ireland, an appellate juriſdiction (in the laſt reſort) is veſted in this tribunal; which uſually exerciſes its judicial authority in a committee of the whole privy-council, who hear the allegations and proofs, and make their report to his majeſty in council, by whom the judgment is finally given.

Anciently, to ſtrike in the houſe of a privy-counſellor, or elſewhere in his preſence, was grievouſly puniſhed: by 3 Hen. VII. cap. 14. if any of the king's ſervants of his houſehold conſpire or imagine to take away the life of a privy-counſellor, it is felony, though nothing ſhall be done upon it; and by 9 Ann. cap. 16. it is enacted, that any perſons who ſhall unlawfully attempt to kill, or ſhall unlawfully aſſault, and ſtrike, or wound, any privy-counſellor in the execution of his office, ſhall be felons, and ſuffer death as ſuch. With advice of this council, the king iſſues proclamations that bind the ſubject, provided they be not contrary to law. In debates, the loweſt delivers his opinion firſt, the king laſt; and thereby determines the matter. A council is never held without the preſence of a ſecretary of ſtate.

The diſſolution of the privy-council depends upon the kings pleaſure; and he may, whenever he thinks proper, diſcharge any particular member, or the whole of it, and appoint another. By the common law alſo it was diſſolved *ipſo facto* by the king's demiſe, or deriving all its authority from him. But now, to prevent the inconveniences of having no council in being at the acceſſion of a new prince, it is enacted, by 6 Ann, cap. 7. that the privy-council ſhall continue for ſix months after the demiſe of the crown, unleſs ſooner determined by the ſucceſſor. *Blackſt. Com.* book i. p. 229, &c.

The officers of the privy-council are four clerks of the council in ordinary, three clerks extraordinary, a keeper of the records, and two keepers of the council-chamber. See PRESIDENT.

PRIVY Seal, a ſeal which the king uſes previouſly to ſuch grants, &c. as are afterwards to paſs the great ſeal.

The privy ſeal is alſo ſometimes uſed in matters of leſs conſequence, which do not require the great ſeal.

Lord PRIVY Seal. See *KEEPER of the Privy Seal.*

Clerks of the PRIVY Seal. See CLERK.

PRIVY Chamber. See CHAMBER.

PRIZE, or PRISE, in maritime affairs, a veſſel taken at ſea from the enemies of a ſtate, or from pirates; and that either by a man of war, a privateer, &c. having a commiſſion for that purpoſe.

Veſſels are looked on as prize, if they fight under any other ſtandard than that of the ſtate from which they have their commiſſion; if they have no charter-party, invoice, or bill of lading aboard; if loaded with effects belonging to the king's enemies, or with contraband goods.

In Britiſh ſhips of war, the priſes are to be divided among the officers, ſeamen, &c. as his majeſty ſhall appoint by proclamation; but among privateers, the diviſion is according to the agreement between the owners.

By ſtat. 13. Geo. II. c. 4. judges and officers, failing of their duty in reſpect to the condemnation of prizes, forfeit L. 500, with full coſts of ſuit; one moiety to the king, and the other to the informer.

PROA, FLYING, in navigation, is a name given to a veſſel uſed in the ſouth ſeas, becauſe with a briſk trade-wind it ſails near 20 miles an hour. In the conſtruction of the proa, the head and ſtern are exactly alike, but the ſides are very different; the ſide intended to be always the lee-ſide being flat; and the windward ſide made rounding, in the manner of other veſſels; and, to prevent her over-ſetting, which from her ſmall breadth, and the ſtraight run of her leeward ſide, would, without this precaution, infallibly happen, there is a frame laid out to her from windward, to the end of which is faſtened a log, faſhioned into the ſhape of a ſmall boat, and made hollow. The weight of the frame

Plate CCCCXVI

Pristis.

Fig. 4.

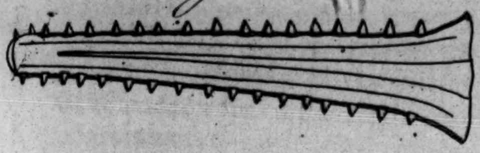


Fig. 2.

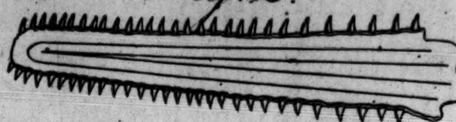


Fig. 1.

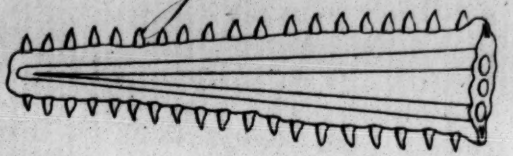
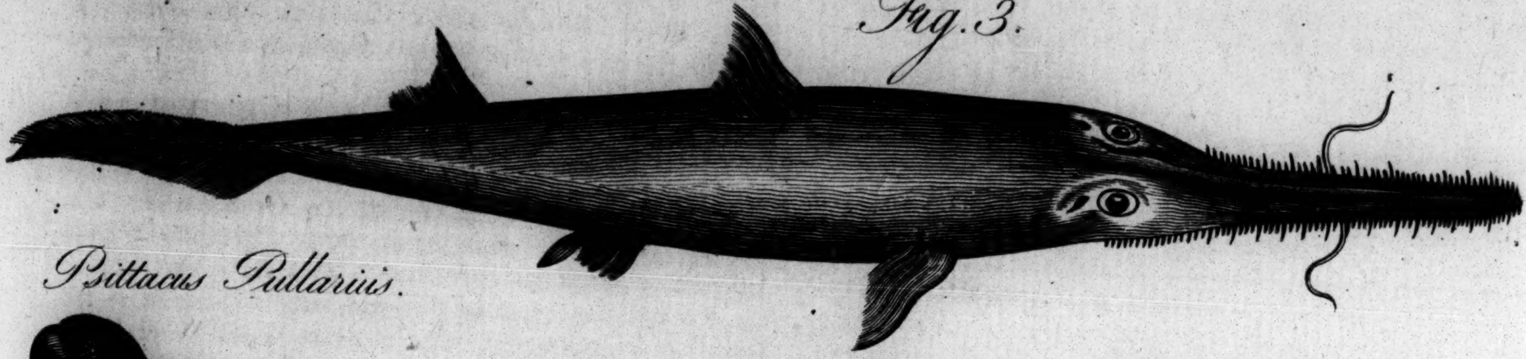
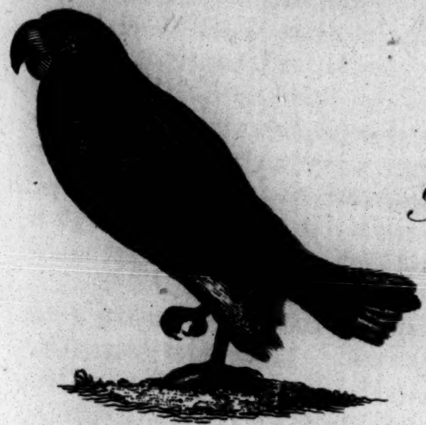


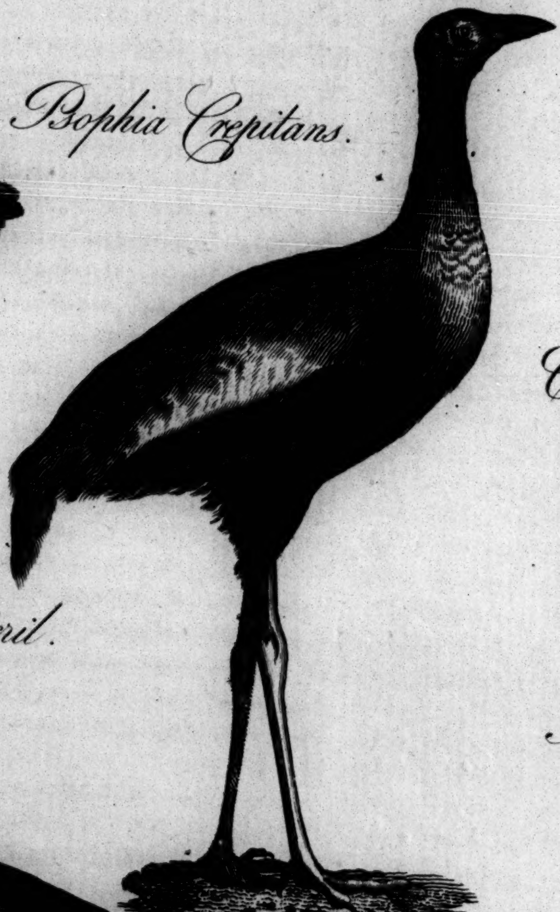
Fig. 3.



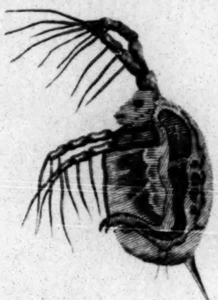
Psittacus Pullarius.



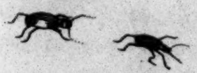
Bophia Crepitans.



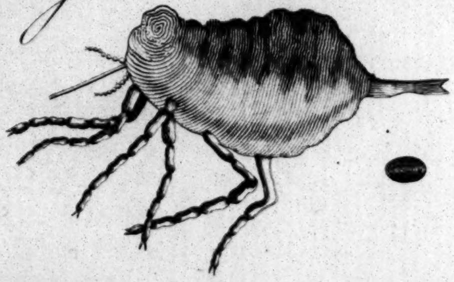
Pulex Monoculus.



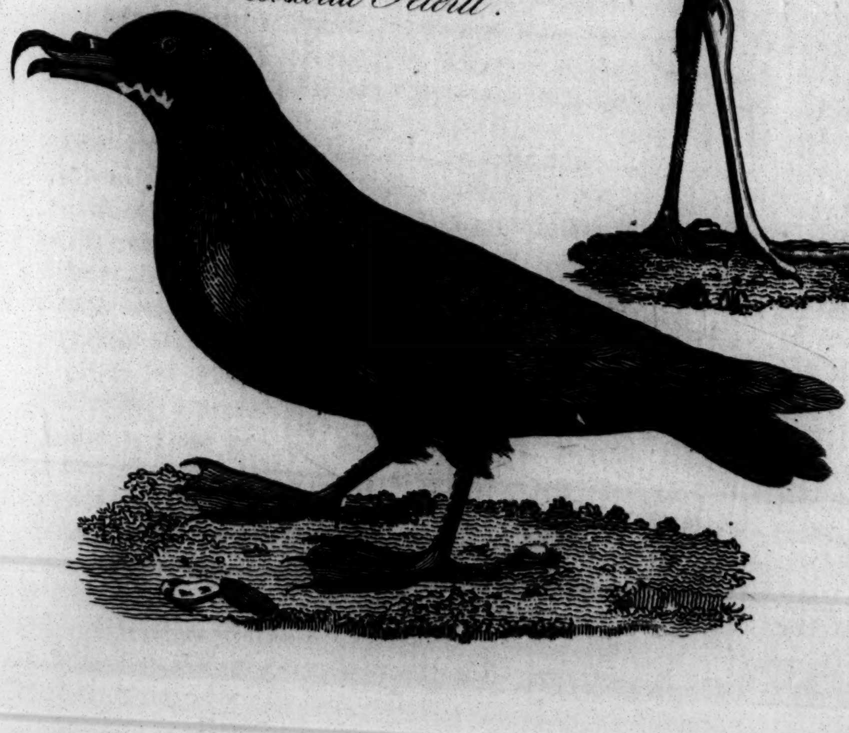
Ptini.



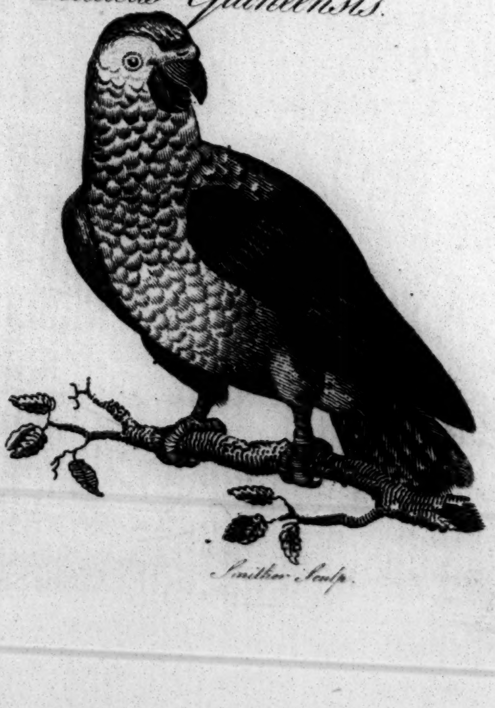
Chego or Pulex Minimus



Procellaria Peteril.



Psittacus Guineensis.



Smither Sculp.

BRITISH MUSEUM

frame is intended to balance the proa, and the ſmall boat is by its buoyancy (as it is always in the water) to prevent her overſetting to windward; and this frame is uſually called an outrigger. The body of the veſſel is made of two pieces joined endwiſe, and ſewed together with bark, for there is no iron uſed about her; ſhe is about two inches thick at the bottom, which, at the gunwale, is reduced to leſs than one. The ſail is made of matting, and the maſt, yard, boom, and outriggers, are all made of bamboo. See *Anſon's Voyage*, quarto, p. 341.

PROBABILITY is a word of nearly the ſame import with likelihood. It denotes the appearance of truth, or that evidence ariſing from the preponderation of argument which produces opinion. (See OPINION.) Locke claſſes all arguments under the heads of *demonſtrative* and *probable*: Hume with greater accuracy divides them into *demonſtrations*, *proofs*, and *probabilities*. Demonſtration produces *ſcience*; proof, *belief*; and probability, *opinion*.

Hardly any thing is ſuſceptible of ſtrict demonſtration beſides the mathematical ſciences, and a few propoſitions in metaphyſical theology. Phyſics reſt upon principles capable, ſome of them, of complete proof by experience, and others of nothing more than probability by analogical reaſoning. What has *uniformly* happened, we expect with the fulleſt confidence to happen again in ſimilar circumſtances; what has *frequently* happened, we likewiſe expect to happen again; but our expectation is not confident. Uniform experience is proof; frequent experience is probability. The ſtrongeſt man has *always* been able to lift the greateſt weight; and therefore, knowing that one man is ſtronger than another, we expect, with confidence, that the former will lift more than the latter. The beſt diſciplined army has *generally* proved victorious, when all other circumſtance were equal. We therefore expect that an army of veterans will, upon fair ground, defeat an equal number of new levied troops: but as ſudden panics have ſometimes ſeized the oldeſt ſoldiers, this expectation is accompanied with doubt, and the utmoſt that we can ſay of the expected event is, that it is *probable*; whereas in the competitions between the two men, we look upon it as *morally certain*. (See METAPHYSICS, part 1. chap. vii. ſec. 3.) When two or three perſons of known veracity atteſt the ſame thing as conſiſtent with their knowledge, their teſtimony amounts to *proof*, if not contradicted by the teſtimony of others; if contradicted, it can, at the utmoſt, amount only to probability. In common language we talk of *circumſtantial* proofs and *preſumptive* proofs; but the expreſſions are improper, for ſuch evidence amounts to nothing more than probability. Of probability there are indeed various degrees from the confines of certainty down to the confines of impoſſibility; and a variety of circumſtances tending to the ſame point, though they amount not to what, in ſtrictneſs of language, ſhould be called *proof*, afford to the mind a very high degree of evidence, upon which, with the addition of one direct teſtimony, the laws of many countries take away the life of a man.

PROBABILITY *of an Event*, in the *Doctrine of Chances*, is greater or leſs according to the number of chances by which it may happen or fail. (See EXPECTATION). The *probability of life* is liable to the rules of computation. In the *Encyclopedie Methodique*, we find a table of the probabilities of the duration of life, conſtructed from that which is to be found in the ſeventh volumee of the *Supplemens à l'Hiſtoire de M. de Buffon*; of which the following is an abridgement.

Of 23,994 children born at the ſame time, there will probably die

$\frac{1}{3}$	In one year - -	7998
$\frac{2}{3}$	Remaining $\frac{2}{3}$ or 15996	
$\frac{1}{2}$	In eight years - -	11997
$\frac{1}{2}$	Remaining $\frac{1}{2}$ or 11997	
$\frac{2}{3}$	In thirty eight years -	15996
$\frac{1}{3}$	Remaining $\frac{1}{3}$ or 7998	
$\frac{3}{4}$	In fifty years -	17994
$\frac{1}{4}$	Remaining $\frac{1}{4}$ or 5998	
$\frac{5}{6}$	In ſixty one years -	19995
$\frac{1}{6}$	Remaining $\frac{1}{6}$ or 3999	
$\frac{9}{10}$	In ſeventy years -	21595
$\frac{1}{10}$	Remaining $\frac{1}{10}$ or 2399	
$\frac{39}{40}$	In eighty years -	22395
$\frac{1}{40}$	Remaining $\frac{1}{40}$ or 599	
$\frac{299}{300}$	In ninety years -	23914
$\frac{1}{300}$	Remaining $\frac{1}{300}$ or 80	
	In an hundred years -	23992

Remaining $\frac{1}{10000}$ or 2. See *Bills of* MORTALITY.

PROBATE of a will or teſtament, in law, is the exhibiting and proving of laſt wills and teſtaments before the officer delegated by the government of the place where the party died.

PROBATION, in the univerſities, is the examination and trial of a ſtudent who is about to take his degrees.

PROBATION, in a monaſtic ſenſe, ſignifies the year of a novitiate, which a religious muſt paſs in a convent, to prove his virtue and vocation, and whether he can bear the ſeverities of the rule.

PROBATION, in Scots law. See LAW, p. 714.

PROBATIONER, in the church of Scotland, a ſtudent in divinity, who bringing a certificate from a profeſſor in an univerſity of his good morals, and his having performed his exerciſes to approbation, is admitted to undergo ſeveral trials; and, upon his acquitting himſelf properly in theſe, receives a licence to preach.

PROBATUM EST *(It is proved)*, a term frequently ſubjoined to a receipt for the cure of ſome diſeaſe.

PROBE, a ſurgeon's inſtrument for examining the circumſtances of wounds, ulcers, and other cavities, ſearching for ſtones in the bladder, &c.

PROBITY means honeſty, ſincerity, or veracity; and conſiſts in the habit of actions uſeful to ſociety, and in the conſtant obſervance of the laws which juſtice and conſcience impoſe on us. The man who obeys all the laws of ſociety, with an exact punctuality is not therefore a man of probity; laws can only reſpect the external and definite parts of human conduct, but probity reſpects our more private actions, and ſuch as it is impoſſible in all caſes to define; and it appears to be in morals what charity is in religion. Probity teaches us to perform in ſociety thoſe actions which no external power can oblige us to perform, and is that quality in the human mind from which we claim the performance of the *rights* commonly called *imperfect*. See MORAL PHILOSOPHY.

PROBLEM, in logic, is a propoſition that neither appears abſolutely true nor falſe; and, conſequently, may be aſſerted either in the affirmative or negative.

Problem, in geometry, is a propoſition, wherein ſome operation or conſtruction is required; as to divide a line or angle, erect or let fall perpendiculars, &c. See Geometry.

PROBOSCIS, in natural hiſtory, is the trunk or ſnout of an elephant, and ſome other animals and inſects.

Flies, gnats, &c. are furniſhed with a proboſcis or trunk; by means of which they ſuck the blood of animals, the juice of vegetables, &c. for their food.

PROBUS (Marcus Aurelius), from the ſon of a gardener, became, by his great valour as a ſoldier, and his eminent virtues, emperor of Rome, to which dignity he was raiſed by the army. After having ſubdued the barbarous nations that had made incurſions into different parts of the empire, where they committed horrid cruelties, and governed with great wiſdom and clemency, he was maſſacred in the 7th year of his reign, by ſome ſoldiers who were weary of the public works at which he made them labour, in 282.

POCATARCTIC cause, in medicine, the pre-exiſting, or prediſpoſing cauſe or occaſion of a diſeaſe.

PROCELEUSMATICUS, in the ancient poetry, a foot conſiſting of four ſhort ſyllables, or two pyrrhychiuſes; as *hominibus*.

PROCELLARIA, in ornithology; a genus of birds, belonging to the order of anſeres. The beak is ſomewhat compreſſed, and without teeth; the mandibles are equal, the ſuperior one being crooked at the point; the feet are palmated, the hind claw being ſeſſile, without any toe. Mr Latham (See his *Index Ornithologicus*, p. 820.) enumerates 24 ſpecies, which are principally diſtinguiſhed by their colour. The moſt remarkable are,

1. The cinerea, or petrel. The ſize of this bird is rather ſuperior to that of the common gull: the bill very ſtrong, much hooked at the end, and of a yellow colour. The noſtrils are compoſed of two large tubes, lodged in one ſheath: the head, neck, whole under ſide of the body, and tail, are white: the back and coverts of the wings aſh-coloured: the quill-feathers duſky: and the legs yellowiſh. In lieu of a back toe, it has only a ſort of ſpur, or ſharp ſtraight nail. Theſe birds feed on the blubber or fat of whales, &c. which being ſoon convertible into oil, ſupplies them conſtantly with means of defence, as well as proviſion for their young, which they caſt up into their mouths. They are likewiſe ſaid to feed on ſorrel, which they uſe to qualify the unctuous diet they live on. This ſpecies inhabits the iſle of St Kilda; makes its appeance there in November, and continues the whole year, except September and October; it lays a large, white, and very brittle egg; and the young are hatched the middle of June. No bird is of ſuch uſe to the iſlanders as this: the fulmar ſupplies them with oil for their lamps, down for their beds, a delicacy for their tables, a balm for their wounds, and a medicine for their diſtempers. The fulmar is alſo a certain prognoſticator of the change of the wind: if it comes to land, no weſt wind is expected for ſome time; and the contrary when it returns and keeps the ſea. The whole genus of petrels have a peculiar faculty of ſpouting from their bills, to a conſiderable diſtance, a large quantity of pure oil; which they do, by way of defence, into the face of any one that attempts to take them: ſo that they are, for the ſake of this panacæa, ſeized by ſurpriſe; as this oil is ſubſervient to the abovementioned medical purpoſes. Martin tells us, it has been uſed in London and Edinburgh with ſucceſs in rheumatic caſes. Frederick Martens, who had opportunity of ſeeing vaſt numbers of theſe birds at Spitzbergen, obſerves, that they are very bold, and reſort after the whale-fiſhers in great flocks; and that, when a whale is taken, they will, in ſpite of all endeavours, light on it and pick out large lumps of fat, even when the animal is alive: That the whales are often diſcovered at ſea by the multitudes of them flying; and that when one of the former are wounded, prodigious multitudes immediately follow its bloody track. He adds, that it is a moſt gluttonous bird, eating till it is forced to diſgorge itſelf.

2. The puffinus, or ſhear-water, is 15 inches in length; the breadth 31; the weight 17 ounces: the bill is an inch and three quarters long; noſtrils tubular, but not very prominent: the head, and whole upper ſide of the body, wings, tail, and thighs, are of a ſooty blackneſs; the under ſide from chin to tail, and inner coverts of the wings, white: the legs weak, and compreſſed ſidewiſe; duſky behind, whitiſh before. Theſe birds are found in the Calf of Man; and, as Mr Ray ſuppoſes, in the Scilly iſles. They reſort to the former in February; take a ſhort poſſeſſion of the rabbet-burrows, and then diſappear till April. They lay one egg, white and blunt at each end; and the young are fit to be taken the beginning of Auguſt; when great numbers are killed by the perſon who farms the iſle: they are ſalted and barrelled; and when they are boiled, are beaten with potatoes. During the day they keep at ſea, fiſhing; and towards evening return to their young; whom they feed, by diſcharging the contents of their ſtomachs into their mouths; which by that time is turned into oil: by reaſon of the backward ſituation of their legs, they ſit quite erect. They quit the iſle the latter end of Auguſt, or beginning of September; and, from accounts lately received from navigators, we have reaſon to imagine that like the ſtorm-finch, they are diſperſed over the whole Atlantic ocean. This ſpecies inhabits alſo the Orkney iſles, where it makes its neſt in holes on the earth near the ſhelves of the rocks and headlands: it is called there the *lyre*; and is much valued, both on account of its being a food, and for its feathers. The inhabitants take and ſalt them in Auguſt for winter proviſions, when they boil them with cabbage. They alſo take the old ones in March; but they are then poor, and not ſo well taſted as the young: they appear firſt in thoſe iſlands in February.

3. The pelagica, or ſtormy petrel, is about the bulk of the houſe-ſwallow: the length ſix inches; the extent of wings, 13. The whole bird is black except the coverts of the tail and vent-feathers, which are white: the bill is hooked at the end: the noſtrils tubular: the legs ſlender, and long. It has the ſame faculty of ſpouting oil from its bill as the other ſpecies: and Mr Brunnich tells us, that the inhabitants of the Ferroe iſles make this bird ſerve the purpoſes of a candle, by drawing a wick through the mouth and rump, which being lighted, the flame is fed by the fat and oil of the body. Except in breeding-time, it is always at ſea; and is ſeen all over the vaſt Atlantic ocean, at the greateſt

diſtance

Procellaria.
Proceſs.

diſtance from land; often following the veſſels in great flocks, to pick up any thing that falls from on board: for trial ſake, chopped ſtraw has been flung over, which they would ſtand on with expanded wings; but were never obſerved to ſettle on or ſwim in the water: it preſages bad weather, and cautions the ſeamen of the approach of a tempeſt, by collecting under the ſtern of the ſhips: it braves the utmoſt fury of the ſtorm, ſometimes ſkimming with incredible velocity along the hollows of the waves, ſometimes on the ſummits: Cluſius makes it the Camilla of the ſea.

Vel mare per medium fluctu ſuſpenſa tumenti
Ferret iter, celeres nec tingeret æquore plantas. VIRG.

She ſwept the ſeas; and, as ſhe ſkimm'd along,
Her flying feet unbath'd on billows hung. DRYDEN.

Theſe birds are the *cypſelli* of Pliny, which he places among the *apodes* of Ariſtotle; not becauſe they wanted feet, but were Κακοποδα, or had bad or uſeleſs ones; an attribute he gives to theſe ſpecies, on a ſuppoſition that they were almoſt always on the wing. In Auguſt 1772, Mr Pennant found them on the rocks called *Macdonald's Table*, off the north end of the iſle of Skie; ſo conjectures they breed there. They lurked under the looſe ſtones, but betrayed themſelves by their twittering noiſe.

In Mr White's *Journal of a Voyage to New South Wales* we have a figure of the fuliginous petrel, with a whitiſh beak; which he takes to be a variety of the *Procellaria Æquinoctialis* of Linnæus. It is nearly of the ſize of a raven; its colour is a deep ſooty brown or blackiſh; on the chin there is a ſmall patch of white running down a little on each ſide from the lower mandible; the beak is of a yellowiſh white. See Plate CCCCXVI. Captain Bligh, in his *Voyage to the South Seas*, in S. Lat. 60. 1. and W. Long. 71. 45. ſaw both petrels and pintadas; ſome of which he took with baited hooks.

PROCESS, in law, denotes the proceedings in any cauſe, real or perſonal, civil or criminal, from the original writ to the end thereof.

In a more limited ſenſe, proceſs denotes that by which a man is called firſt into any temporal court.

It is the next ſtep for carrying on the ſuit, after ſuing out the original writ. See SUIT and WRIT.

Blackſt. Comment.

It is the method taken by the law to compel a compliance with the original writ, of which the primary ſtep is by giving the party notice to obey it. This notice is given upon all real *præcipes*; and alſo upon all perſonal writs for injuries not againſt the peace, by *ſummons*; which is a warning to appear in court at the return of the original writ, given to the defendant by two of the ſheriff's meſſengers called *ſummoners*, either in perſon, or left at his houſe or land: in like manner as in the civil law the firſt proceſs is by perſonal citation, *in jus vocando*. This warning on the land is given, in real actions, by erecting a white ſtick or wand on the defendant's grounds (which ſtick or wand among the northern nations is called the *baculus nunciatorius*), and by ſtatute 31 Eliz. c. 3. the notice muſt alſo be proclaimed on ſome Sunday before the door of the pariſh-church.

If the defendant diſobeys this verbal monition, the next proceſs is by writ of *attachment* or *pone*; ſo called from the words of the writ, *pone per vadium et ſalvos plegios*, "put by gage and ſafe pledges A. B. the defendant," &c. This is a writ not iſſuing out of chancery, but out of the court of common-pleas, being grounded on the non-appearance of the defendant at the return of the original writ; and thereby the ſheriff is commanded to attach him, by taking *gage*, that is, certain of his goods, which he ſhall forfeit if he doth not appear; or by making him find *ſafe pledges* or ſureties, which ſhall be amerced in caſe of his non-appearance. This is alſo the firſt and immediate proceſs, without any previous ſummons, upon actions of treſpaſs *vi et armis*, or for other injuries, which, though not forcible, are yet treſpaſſes againſt the peace, as *deceit* and *conſpiracy*; where the violence of the wrong requires a more ſpeedy remedy, and therefore the original writ commands the defendant to be at once attached, without any precedent warning.

If, after attachment, the defendant neglects to appear, he not only forfeits this ſecurity, but is moreover to be farther compelled by writ of *diſtringas*, or diſtreſs infinite: which is a ſubſequent proceſs iſſuing from the court of common-pleas, commanding the ſheriff to diſtrain the defendant from time to time, and continually afterwards, by taking his goods and the profits of his lands, which are called *iſſues*, and which he forfeits to the king if he doth not appear. But the iſſues may be ſold, if the court ſhall ſo direct, in order to defray the reaſonable coſts of the plaintiff. In like manner, by the civil law, if the defendant abſconds, ſo that the citation is of no effect, *mittitur adverſarius in poſſeſſionem bonorum ejus*.

And here, by the common as well as the civil law, the proceſs ended in caſe of injuries without force: the defendant if he had any ſubſtance, being gradually ſtripped of it all by repeated diſtreſſes, till he rendered obedience to the king's writ; and, if he had no ſubſtance, the law held him incapable of making ſatisfaction, and therefore looked upon all further proceſs as nugatory. And beſides, upon feodal principles, the perſon of a feudatory was not liable to be attached for injuries merely civil, leſt thereby his lord ſhould be deprived of his perſonal ſervices. But, in caſes of injury accompanied with force, the law, to puniſh the breach of the peace and prevent its diſturbance for the future, provided alſo a proceſs againſt the defendant's perſon, in caſe he neglected to appear upon the former proceſs of attachment, or had no ſubſtance whereby to be attached; ſubjecting his body to impriſonment by the writ of *capias ad reſpondendum*. But this immunity of the defendant's perſon, in caſe of peaceable though fraudulent injuries, producing great contempt of the law in indigent wrongdoers, a *capias* was alſo allowed, to arreſt the perſon in actions of account, though no breach of the peace be ſuggeſted, by the ſtatutes of Marlbridge, 52 Hen. III. c. 23. and Weſtm. 2. 13 Edw. I. c. 11. in actions of debt and detinue, by ſtatute 25 Edw. III. c. 17. and in all actions on the caſe, by ſtatute 19 Hen. VII. c. 9. Before which laſt ſtatute a practice had been introduced of commencing the ſuit by bringing an original writ of treſpaſs *quare clauſum fregit*, by breaking the plaintiff's cloſe, *vi et armis*; which by the old common law ſubjected the defendant's perſon to be arreſted by writ of *capias*: and then afterwards, by connivance of the court the plaintiff might proceed to proſecute for any other leſs forcible injury. This practice (through cuſtom rather than neceſſity, and for ſaving ſome trouble and expence

pence, in ſuing out a ſpecial original adapted to the particular injury) ſtill continues in almoſt all caſes, except in actions of debt; though now, by virtue of the ſtatutes above cited and others, a *capias* might be had upon almoſt every ſpecies of complaint.

If therefore the defendant, being ſummoned or attached, makes default, and neglects to appear; or if the ſheriff returns a *nihil*, or that the defendant hath nothing whereby he may be ſummoned, attached, or diſtrained, the *capias* now uſually iſſues: being a writ commanding the ſheriff to take the body of the defendant, if he may be found in his bailiwick or county, and him ſafely to keep, ſo that he may have him in court on the day of the return, to anſwer to the plaintiff of a plea of debt, or treſpaſs, &c. as the caſe may be. This writ, and all others ſubſequent to the original writ, not iſſuing out of chancery, but from the court into which the original was returnable, and being grounded on what has paſſed in that court in conſequence of the ſheriff's return, are called *judicial*, not *original*, writs; they iſſue under the private ſeal of that court, and not under the great ſeal of England; and are *teſted*, not in the king's name, but in that of the chief juſtice only. And theſe ſeveral writs being grounded on the ſheriff's return, muſt reſpectively bear date the ſame day on which the writ immediately preceding was returnable.

This is the regular and orderly method of proceſs. But it is now uſual in practice to ſue out the *capias* in the firſt inſtance, upon a ſuppoſed return of the ſheriff; eſpecially if it be ſuſpected that the defendant, upon notice of the action, will abſcond; and afterwards a fictitious original is drawn up, with a proper return thereupon, in order to give the proceedings a colour of regularity. When this *capias* is delivered to the ſheriff, he by his under-ſheriff grants a warrant to his inferior officers or bailiffs to execute it on the defendant. And, if the ſheriff of Oxfordſhire (in which county the injury is ſuppoſed to be committed and the action is laid) cannot find the defendant in his juriſdiction, he returns that he is not found, *non eſt inventus*, in his bailiwick; whereupon another writ iſſues, called a *teſtatum capias*, directed to the ſheriff of the county where the defendant is ſuppoſed to reſide, as if Berkſhire, reciting the former writ, and that it is teſtified, *teſtatum eſt*, that the defendant lurks or wanders in his bailiwick, where he is commanded to take him, as in the former *capias*. But here alſo, when the action is brought in one county and the defendant lives in another, it is uſual, for ſaving trouble, time, and expence, to make out a *teſtatum capias* at the firſt; ſuppoſing not only an original, but alſo a former *capias*, to have been granted; which in fact never was. And this fiction, being beneficial to all parties, is readily acquieſced in, and is now become the ſettled practice; being one among many inſtances to illuſtrate that maxim of law, that *in fictione juris conſiſtit æquitas*.

But where a defendant abſconds, and the plaintiff would proceed to an outlawry againſt him, an original writ muſt then be ſued out regularly, and after that a *capias*. And if the ſheriff cannot find the defendant upon the firſt writ of *capias*, and returns a *non eſt inventus*, there iſſues out an *alias* writ, and after that a *pluries*, to the ſame effect as the former: only after theſe words "we command you," this clauſe is inſerted, "as we have formerly," or, "as we have often commanded you;"—"*ſicut* alias," or, "*ſicut* pluries, *præcepimus*." And if a *non eſt inventus* is returned upon all of them, then a writ of *exigent* or *exigi facias* may be ſued out, which requires the ſheriff to cauſe the defendant to be proclaimed, required, or exacted, in five county-courts ſucceſſively, to render himſelf; and if he does, then to take him, as in a *capias*: but if he does not appear, and is returned *quinto exactus*, he ſhall then be outlawed by the coroners of the county. Alſo by ſtatute 6 Hen. VIII. c. 4. and 31 Eliz. c. 3. whether the defendant dwells within the ſame or another county than that wherein the *exigent* is ſued out, a *writ of proclamation* ſhall iſſue out at the ſame time with the *exigent*, commanding the ſheriff of the county, wherein the defendant dwells, to make three proclamations thereof in places the moſt notorious, and moſt likely to come to his knowledge, a month before the outlawry ſhall take place. Such outlawry is putting a man out of the protection of the law, ſo that he is incapable to bring an action for redreſs of injuries; and it is alſo attended with a forfeiture of all one's goods and chattels to the king. And therefore, till ſome time after the conqueſt, no man could be outlawed but for felony: but in Bracton's time, and ſomewhat earlier, proceſs of outlawry was ordained to lie in all actions for treſpaſſes *vi et armis*. And ſince, by a variety of ſtatutes (the ſame which allow the writ of *capias* before-mentioned) proceſs of outlawry doth lie in divers actions that are merely civil; providing they be commenced by original and not by bill. If after outlawry the defendant appears publicly, he may be arreſted by a writ of *capias utlagatum*, and committed till the outlawry be reverſed. Which reverſal may be had by the defendant's appearing perſonally in court (and in the king's bench without any perſonal appearance, ſo that he appears by attorney, according to ſtatute 4 & 5 W. & M. c. 18.) and any plauſible cauſe, however ſlight, will in general be ſufficient to reverſe it, it being conſidered only as a proceſs to compel an appearance. But then the defendant muſt pay full coſts, and put the plaintiff in the ſame condition as if he had appeared before the writ of *exigi facias* was awarded.

Such is the firſt proceſs in the court of common pleas. In the king's bench they may alſo (and frequently do) proceed in certain cauſes, particularly in actions of ejectment and treſpaſs, by *original* writ, with *attachment* and *capias* thereon; returnable, not at Weſtminſter, where the common pleas are now fixed in conſequence of *magna charta*, but *ubicunque fuerimus in Anglia*, whereſoever the king ſhall then be in England; the king's bench being removable into any part of England at the pleaſure and diſcretion of the crown. But the more uſual method of proceeding therein is without any original but by a peculiar ſpecies of proceſs intitled a *bill of Middleſex*; and therefore ſo intitled, becauſe the court now ſits in that county; for if it ſat in Kent, it would then be a bill of Kent. For though, as the juſtices of this court have, by its fundamental conſtitution, power to determine all offences and treſpaſſes, by the common law and cuſtom of the realm, it needed no original writ from the crown to give it cognizance of any miſdemeſnor in the county wherein it reſides; yet as, by this court's coming into any county, it immediately ſuperſeded the ordinary adminiſtration of juſtice by the general commiſſions of *eyre* and of *oyer and terminer*, a proceſs of its own became neceſſary, within the county it ſat, to bring in ſuch perſons as were accuſed of committing any forcible injury. The bill of Middleſex (which was formerly always founded on a plaint of treſpaſs *quare clauſum fregit*, entered on the records of the court) is a kind of *capias*, directed to the ſheriff of that county, and commanding him to take the defendant, and have him before his lord the king at Weſtminſter on a day prefixed, to anſwer to the plaintiff of a plea of treſpaſs. For this accuſation of treſpaſs it is that gives the court of king's bench juriſdiction in other civil cauſes, ſince, when once the defendant is taken into cuſtody of the marſhal, or priſon-keeper of this court, for the ſuppoſed treſpaſs, he, being then a priſoner of this court, may here be proſecuted for any other ſpecies of injury. Yet, in order to found this juriſdiction, it is not neceſſary that the defendant be actually the marſhal's priſoner; for, as ſoon as he appears, or puts in bail, to the proceſs, he is deemed by ſo doing to be in ſuch cuſtody of the marſhal as will give the court a juriſdiction to proceed. And, upon theſe accounts, in the bill or proceſs, a complaint of treſpaſs is always ſuggeſted, whatever elſe may be the real cauſe of action. This bill of Middleſex muſt be ſerved on the defendant by the ſheriff, if he finds him in that county: but if he returns, *non eſt inventus*, then there iſſues out a writ of *latitat*, to the ſheriff of another county, as Berks; which is ſimilar to the *teſtatum capias* in the common pleas, and recites the bill of Middleſex and the proceedings thereon, and that it is teſtified that the defendant *latitat et diſcurrit*, lurks and wanders about in Berks; and therefore commands the ſheriff to take him, and have his body in court on the day of the return. But as in the common pleas the *teſtatum capias* may be ſued out upon only a ſuppoſed, and not an actual preceding, *capias*; ſo in the king's bench a *latitat* is uſually ſued out upon only a ſuppoſed, and not an actual, bill of Middleſex. So that, in fact, a *latitat* may be called the firſt proceſs in the court of king's bench, as the *teſtatum capias* is in the common pleas. Yet, as in the common pleas, if the defendant lives in the county wherein the action is laid, a common *capias* ſuffices; ſo in the king's bench likewiſe, if he lives in Middleſex, the proceſs muſt ſtill be by bill of Middleſex only.

In the exchequer the firſt proceſs is by writ of *quo minus*, in order to give the court a juriſdiction over pleas between party and party. In which writ the plaintiff is alleged to be the king's farmer or debtor, and that the defendant hath done him the injury complained of, *quo minus ſufficiens exiſtit*, by which he is the leſs able to pay the king his rent or debt. And upon this the defendant may be arreſted as upon a *capias* from the common pleas.

Thus differently do the three courts ſet out at firſt, in the commencement of a ſuit, in order to intitle the two courts of king's bench and exchequer to hold plea in ſubjects cauſes, which by the original conſtitution of Weſtminſter-hall they were not empowered to do. Afterwards, when the cauſe is once drawn into the reſpective courts, the method of purſuing it is pretty much the ſame in all of them.

If the ſheriff had found the defendant upon any of the former writs, the *capias latitat*, &c. he was anciently obliged to take him into cuſtody, in order to produce him in court upon the return, however ſmall and minute the cauſe of action might be. For, not having obeyed the original ſummons, he had ſhown a contempt of the court, and was no longer to be truſted at large. But when the ſummons fell into diſuſe, and the *capias* became in fact the firſt proceſs, it was thought hard to impriſon a man for a contempt which was only ſuppoſed: and therefore, in common caſes, by the gradual indulgence of the courts (at length authoriſed by ſtatute 12 Geo. I. c. 29. which was amended by ſtatute 5. Geo. II. c. 27. and made perpetual by ſtatute 21 Geo. II. c. 3.) the ſheriff or his officer can now only perſonally ſerve the defendant with the copy of the writ or proceſs, and with notice in writing to appear by his attorney in court to defend this action; which in effect reduces it to a mere ſummons. And if the defendant thinks proper to appear upon this notice, his appearance is recorded, and he puts in ſureties for his future attendance and obedience; which ſureties are called *common bail*, being the ſame two imaginary perſons that were pledges for the plaintiff's proſecution, John Doe and Richard Roe. Or, if the defendant does not appear upon the return of the writ, or within four (or in ſome caſes eight) days after, the plaintiff may enter an appearance for him, as if he had really appeared; and may file common bail in the defendant's name, and proceed thereupon as if the defendant had done it himſelf.

But if the plaintiff will make affidavit, or aſſert upon oath, that the cauſe of action amounts to ten pounds or upwards, then in order to arreſt the defendant, and make him put in ſubſtantial ſureties for his appearance, called *ſpecial bail*, it is required by ſtatute 13 Car. II. ſtat. 2. c. 2. that the true cauſe of action ſhould be expreſſed in the body of the writ or proceſs: elſe no ſecurity can be taken in a greater ſum than L. 40. This ſtatute (without any ſuch intention in the makers) had like to have ouſted the king's bench of all its juriſdiction over civil injuries without force: for, as the bill of Middleſex was framed only for actions of treſpaſs, a defendant could not be arreſted and held to bail thereupon for breaches of civil contracts. But to remedy this inconvenience, the officers of the king's bench deviſed a method of adding what is called a clauſe of *ac etiam* to the uſual complaint of treſpaſs; the bill of Middleſex commanding the defendant to be brought in to anſwer the plaintiff of a plea of treſpaſs, *and alſo* to a bill of debt: the complaint of treſpaſs giving cognizance to the court, and that of debt authoriſing the arreſt. In imitation of which, lord chief juſtice North, a few years afterwards, in order to ſave the ſuitors of his court the trouble and expence of ſuing out ſpecial originals, directed, that in the common pleas, beſides the uſual complaint of breaking the plaintiff's cloſe, a clauſe of *ac etiam* might be alſo added to the writ of *capias*, containing the true cauſe of action; as, "that the ſaid Charles the defendant may anſwer to the plaintiff of a plea of treſpaſs in breaking his cloſe: and alſo, *ac etiam* may anſwer him, according to the cuſtom of the court, in a certain plea of treſpaſs upon the caſe, upon promiſes, to the value of L. 20, &c." The ſum ſworn to by the plaintiff is marked upon the back of the writ; and the ſheriff, or his officer the bailiff, is then obliged actually to arreſt or take into cuſtody the body of the defendant, and, having ſo done, to return the writ with a *cepi corpus* indorſed thereon. See ARREST.

When the defendant is regularly arreſted, he muſt either go to priſon, for ſafe cuſtody; or put in *ſpecial bail* to the ſheriff. For, the intent of the arreſt being only to compel an appearance in court at the return of the writ, that purpoſe is equally anſwered, whether the ſheriff detains his perſon, or takes ſufficient ſecurity for his appearance, called *bail* (from the French word *bailler*, "to deliver)," becauſe the defendant is bailed, or delivered, to his ſureties, upon their giving ſecurity for his appearance; and is ſuppoſed to continue in their friendly cuſtody inſtead of going to gaol. See Bail. The method of putting in bail to the ſheriff is by entering into a bond or obligation, with one or more ſureties, (not fictitious perſons, as in the former caſe of common bail, but real, ſubſtantial, reſponſible bondſmen), to inſure the defendant's appearance at the return of the writ; which obligation is called the *bail-bond*. The ſheriff, if he pleaſes, *may* let the defendant go without any ſureties; but that is at his own peril: for, after once taking him, the ſheriff is bound to keep him ſafely, ſo as to be forthcoming in court; otherwiſe an action lies againſt him for an eſcape. But, on the other hand, he is obliged, by ſtatute 23 Hen. VI. c. 10. to take (if it be tendered) a ſufficient bail-bond; and, by ſtatute 12 Geo. I. c. 29. the ſheriff ſhall take bail for no other ſum than ſuch as is ſworn to by the plaintiff, and indorſed on the back of the writ.

Upon the return of the writ, or within four days after, the defendant muſt *appear* according to the exigency of the writ. This *appearance* is effected by putting in and juſtifying bail *to the action;* which is commonly called *putting in bail above*. If this be not done, and the bail that were taken by the ſheriff *below* are reſponſible perſons, the plaintiff may take an aſſignment from the ſheriff of the bail-bond (under the ſtatute 4 & 5 Ann. c. 16.) and bring an action thereupon againſt the ſheriff's bail. But if the bail ſo accepted by the ſheriff be inſolvent perſons, the plaintiff may proceed againſt the ſheriff himſelf, by calling upon him, firſt to return the writ (if not already done), and afterwards to bring in the body of the defendant. And if the ſheriff does not then cauſe ſufficient bail to be put in *above*, he will himſelf be reſponſible to the plaintiff.

The bail *above*, or bail *to the action*, muſt be put in either in open court, or before one of the judges thereof; or elſe, in the country, before a commiſſioner appointed for that purpoſe by virtue of the ſtatute 4 W. & M. c. 4. which muſt be tranſmitted to the court. Theſe bail, who muſt at leaſt be two in number, muſt enter into a recognizance in court, or before the judge or commiſſioner, whereby they do jointly and ſeverally undertake, that if the defendant be condemned in the action, he ſhall pay the coſts and condemnation, or render himſelf a priſoner, or that they will pay it for him: which recognizance is tranſmitted to the court in a ſlip of parchment, intitled a *bail-piece*. And, if required, the bail muſt *juſtify* themſelves in court, or before the commiſſioner in the country, by ſwearing themſelves houſekeepers, and each of them to be worth double the ſum for which they are bail, after payment of all their debts. This anſwers in ſome meaſure to the *ſtipulatio* or *ſatiſdatio* of the Roman laws, which is mutually given by each litigant party to the other: by the plaintiff that he will proſecute his ſuit, and pay the coſts if he loſes his cauſe; in like manner as our law ſtill requires nominal pledges of proſecution from the plaintiff: by the defendant, that he ſhall continue in court, and abide the ſentence of the judge, much like our ſpecial bail; but with this difference, that the *fidejuſſores* were there abſolutely bound *judicatum ſolvere*, to ſee the coſts and condemnation paid at all events: whereas our ſpecial bail may be diſcharged, by ſurrendering the defendant into cuſtody within the time allowed by law; for which purpoſe they are at all times entitled to a warrant to apprehend him.

Special bail is required (as of courſe) only upon actions of debt, or actions on the caſe in trover, or for money due, where the plaintiff can ſwear that the cauſe of action amounts to ten pounds: but in actions where the damages are precarious, being to be aſſeſſed *ad libitum* by a jury, as in actions for words, ejectment, or treſpaſs, it is very ſeldom poſſible for a plaintiff to ſwear to the amount of his cauſe of action; and therefore no ſpecial bail is taken thereon, unleſs by a judge's order, or the particular directions of the court, in ſome peculiar ſpecies of injuries, as in caſes of mayhem or atrocious battery; or upon ſuch ſpecial circumſtances as make it abſolutely neceſſary that the defendant ſhould be kept within the reach of juſtice. Alſo in actions againſt heirs, executors and adminiſtrators, for debts of the deceaſed, ſpecial bail is not demandable; for the action is not ſo properly againſt them in perſon, as againſt the effects of the deceaſed in their poſſeſſion. But ſpecial bail is required even of them, in actions for a *devaſtavit*, or waſting the goods of the deceaſed; that wrong being of their own committing.

Thus much for *proceſs;* which is only meant to bring the defendant into court, in order to conteſt the ſuit, and abide the determination of the law. When he appears either in perſon as a priſoner, or out upon bail, then follow the *pleadings* between the parties. See Pleadings.

Proceſs upon an Indictment. See Prosecution. The proper proceſs on an indictment for any petty miſdemeſnor, or on a penal ſtatute, is a writ of *venire facias*, which is in the nature of a ſummons to cauſe the party to appear. And if by the return to ſuch *venire* it appears that the party hath lands in the county whereby he may be deſtrained, then a *diſtreſs infinite* ſhall be iſſued from time to time till he appears. But if the ſheriff returns, that he hath no lands in his bailiwick, then (upon his non-appearance) a writ of *capias* ſhall iſſue, which commands the ſheriff to take his body, and have him at the next aſſizes; and if he cannot be taken upon the firſt *capias*, a ſecond and a third ſhall iſſue, called an *alias*, and a *pluries capias*. But, on indictments for treaſon or felony, a *capias* is the firſt proceſs: and, for treaſon or homicide, only one ſhall be allowed to iſſue, or two in the caſe of other felonies, by ſtatute 25 Edw. III. c. 14. though the uſage is to iſſue only one in any felony; the proviſions of this ſtatute being in moſt caſes found impracticable. And ſo, in the caſe of miſdemeſnors, it is now the uſual practice for any judge of the court of king's bench, upon certificate of an indictment found, to award a writ of *capias* immediately, in order to bring in the defendant. But if he abſconds, and it is thought proper to purſue him to an outlawry, then a greater exactneſs is neceſſary. For, in ſuch caſe, after the ſeveral writs have iſſued in a regular number, according to the nature of the reſpective crimes, without any effect, the offender ſhall be put in the *exigent* in order to his outlawry: that is, he ſhall be exacted, proclaimed, or required, to ſurrender, at five county-courts; and if he be returned *quinto exactus*, and does not appear at the fifth exaction or requiſition, then he is adjudged to be *outlawed*, or put out of the protection of the law; ſo that he is incapable of taking the benefit of it in any reſpect, either by bringing actions or otherwiſe.

The puniſhment, for outlawries upon indictments for miſdemeſnors, is the ſame as for outlawries upon civil actions; viz. forfeiture of goods and chattels. But an outlawry in treaſon or felony amounts to a conviction and attainder of the offence charged in the indictment, as much as if the offender had been found guilty by his country. His life is, however, ſtill under the protection of the law, as hath elſewhere been obſerved; (ſee HOMICIDE): that though anciently an outlawed felon was ſaid to have *caput lupinum*, and might be knocked on the head like a wolf, by any one that ſhould meet him; becauſe, having renounced all law, he was to be dealt with as in a ſtate of nature, when every one that ſhould find him might ſlay him: yet now, to avoid ſuch inhumanity, it is holden that no man is intitled to kill him wantonly or wilfully; but in ſo doing is guilty of murder, unleſs it happens in the endeavour to apprehend him. For any perſon may arreſt an outlaw on a criminal proſecution, either of his own head, or by writ or warrant of *capias utlagatum*, in order to bring him to execution. But ſuch outlawry may be frequently reverſed by writ of error, the proceedings therein being (as it is fit they ſhould be) exceedingly nice and circumſtantial; and if any ſingle minute point be omitted or miſconducted, the whole outlawry is illegal, and may be reverſed: upon which reverſal the party accuſed is admitted to plead to, and defend himſelf againſt, the indictment.

Thus much for proceſs to bring in the offender after indictment found; during which ſtage of the proſecution it is that writs of *certiorari facias* are uſually had, though they may be had at any time before trial, to certify and remove the indictment, with all the proceedings thereon, from any inferior court of criminal juriſdiction into the court of king's bench; which is the ſovereign ordinary court of juſtice in cauſes criminal. And this is frequently done for one of theſe four purpoſes; either, 1. To conſider and determine the validity of appeals or indictments and the proceedings thereon; and to quaſh or confirm them as there is cauſe; or, 2. Where it is ſurmiſed that a partial or inſufficient trial will probably be had in the court below, the indictment is removed, in order to have the priſoner or defendant tried at the bar of the court of king's bench, or before the juſtices of *niſi prius*: or, 3. It is ſo removed, in order to plead the king's pardon there: or, 4. To iſſue proceſs of outlawry againſt the offender, in thoſe counties or places where the proceſs of the inferior judges will not reach him. Such writ of *certiorari*, when iſſued and delivered to the inferior court for removing any record or other proceeding, as well upon indictment as otherwiſe, ſuperſedes the juriſdiction of ſuch inferior court, and makes all ſubſequent proceedings therein entirely erroneous and illegal; unleſs the court of king's bench remands the record to the court below, to be there tried and determined. A *certiorari* may be granted at the inſtance of either the proſecutor or the defendant: the former as a matter of right, the latter as a matter of diſcretion; and therefore it is ſeldom granted to remove indictments from the juſtices of gaol-delivery, or after iſſue joined, or confeſſion of the fact in any of the courts below.

At this ſtage of proſecution alſo it is, that indictments found by the grand jury againſt a peer, muſt, in conſequence of a writ of *certiorari*, be certified and tranſmitted into the court of parliament, or into that of the lord high ſteward of Great Britain; and that, in places of excluſive juriſdiction, as the two univerſities, indictments muſt be delivered (upon challenge and claim of cognizance) to the courts therein eſtabliſhed by charter, and confirmed by act of parliament, to be there reſpectively tried and determined. See PLEA.

PROCESS, in chemiſtry, the whole courſe of an experiment or ſeries of operations, tending to produce ſomething new.

PROCESS, in anatomy, denotes any protuberance or eminence in a bone.

PROCESSION, a ceremony in the Romiſh church, conſiſting of a formal march of the clergy and people, putting up prayers, &c. and in this manner viſiting ſome church, &c. They have alſo proceſſions of the hoſt or ſacrament, &c. See HOST.

PROCHEIN AMY, in law, the perſon next akin to a child in non-age, and who, in that reſpect, is allowed to act for him, and be his guardian, &c. if he hold land in ſoccage.

To ſue, an infant is not allowed to make an attorney; but the court will admit his next friend as plaintiff, or his guardian as defendant.

PROCKIA, in botany: A genus of the monogynia order, belonging to the polyandria claſs of plants; and in the natural method ranking with thoſe of which the order is doubtful. The calyx is triphyllous, beſides two leafets at the baſe. There is no corolla; the berry is quinqueangular, and polyſpermous.

PROCLAMATION, a public notice given of any thing of which the magiſtrate thinks proper to advertiſe the people.

Proclamations are a branch of the king's prerogative *; and have then a binding force, when (as Sir Edward Coke obſerves) they are grounded upon and enforce the laws of the realm. For, though the making of laws is entirely the work of a diſtinct part, the legiſlative branch of the ſovereign power, yet the manner, time, and circumſtances of putting thoſe laws in execution, muſt frequently be left to the diſcretion of the executive magiſtrate. And therefore his conſtitutions or edicts, concerning thoſe points which we call *proclamations*, are binding upon the ſubject, where they do not either contradict the old laws, or tend to eſtabliſh new ones; but only enforce the execution of ſuch laws as are already in being, in ſuch manner as the king ſhall judge neceſſary. Thus the eſtabliſhed law is, that the king may prohibit any of his ſubjects from leaving the realm: a proclamation therefore forbidding this in general for three weeks, by laying an embargo upon all ſhipping in time of war, will be equally binding as an act of parliament, becauſe founded upon a prior law. But a proclamation to lay an embargo in time of peace upon all veſſels laden with wheat, (though in the time of a public ſcarcity), being contrary to law, and

* See Prerogative.

and particularly to ſtatute 22 Car. II. c. 13. the adviſers of ſuch a proclamation, and all perſons acting under it, found it neceſſary to be indemnified by a ſpecial act of parliament, 7 Geo. III. c. 7. A proclamation for diſarming Papiſts is alſo binding, being only in execution of what the legiſlature has firſt ordained: but a proclamation for allowing arms to Papiſts, or for diſarming any Proteſtant ſubjects, will not bind; becauſe the firſt would be to aſſume a diſpenſing power, the latter a legiſlative one; to the veſting of either of which in any ſingle perſon the laws of England are abſolutely ſtrangers. Indeed, by the ſtatute 31 Hen. VIII. c. 8. it was enacted, that the king's proclamations ſhould have the force of acts of parliament: a ſtatute, which was calculated to introduce the moſt deſpotic tyranny; and which muſt have proved fatal to the liberties of the kingdom, had it not been luckily repealed in the minority of his ſucceſſor, about five years after. By a late act of parliament the king is empowered to raiſe regiments of Roman Catholics, to ſerve in the preſent war.

PROCLUS, ſurnamed DIADOCUS, a Greek philoſopher and mathematician, was born in Lycia, and lived about the year 500. He was the diſciple of Syrianus, and had a great ſhare in the friendſhip of the emperor Anaſtaſius. It is ſaid, that when Vitalian laid ſiege to Conſtantinople, Proclus burnt his ſhips with large brazen ſpeculums. This philoſopher was a Pagan, and wrote againſt the Chriſtian religion. There are ſtill extant his Commentaries on ſome of Plato's books, and other of his works written in Greek.

PROCONSUL, a Roman magiſtrate, ſent to govern a province with conſular authority.

The proconſuls were appointed out of the body of the ſenate; and uſually as the year of any one's conſulate expired, he was ſent proconſul into ſome province.

The proconſuls decided caſes of equity and juſtice, either privately in their pretorium or palace, where they received petitions, heard complaints, granted writs under their ſeal, and the like; or elſe publicly, in the common hall, with the uſual formalities obſerved in the court of judicature at Rome. They had beſides, by virtue of their edicts, the power of ordering all things relating to the tribunes, taxes, contributions, and proviſions of corn and money, &c. Their office laſted only a year. See CONSUL.

PROCOPIUS, a famous Greek hiſtorian, born in Cæſaria, acquired great reputation by his works in the reign of Juſtinian, and was ſecretary to Beliſarius during all the wars carried on by that general in Perſia, Africa, and Italy. He at length became ſenator, obtained the title of *illuſtrious*, and was made pretor of Conſtantinople.

PROCREATION, the begetting and bringing forth young. See GENERATION and SEMEN.

PROCTOR, a perſon commiſſioned to manage another perſon's cauſe in any court of the civil or eccleſiaſtical law.

PROCTOR, in the Engliſh univerſities. See UNIVERSITY.

PROCURATION, an act or inſtrument by which a perſon is empowered to treat, tranſact, receive, &c. in another perſon's name.

PROCURATOR. See PROCTOR.

PRODIGALITY, means extravagance, profuſion, waſte, or exceſſive liberality, and is the oppoſite extreme to the vice of parſimony. By the Roman law, if a man by notorious prodigality was in danger of waſting his eſtate, he was looked upon as *non compos*, and committed to the care of curators, or tutors, by the prætor. And by the laws of Solon, ſuch prodigals were branded with perpetual infamy.

PRODUCT, in arithmetic and geometry, the factum of two or more numbers, or lines, &c. into one another: thus $5\times4=20$ the product required.

PROEDRI, among the Athenians, were magiſtrates, who had the firſt ſeats at the public aſſemblies, and whoſe office it was to propoſe at each aſſembly the things to be deliberated upon and determined. Their office always ended with the meeting. Their number was nine, ſo long as the tribes were ten in number.

PROFANATION, the acting diſreſpectfully to ſacred things.

PROFANE, a term uſed in oppoſition to *holy*; and in general is applied to all perſons who have not the ſacred character, and to things which do not belong to the ſervice of religion.

PROFESSION means a calling, vocation, or known employment. In Knox's *Eſſays*, vol. 1ſt, page 234, we find an excellent paper on the choice of a profeſſion, which that elegant writer concludes thus: "All the occupations of life (ſays he) are found to have their advantages and diſadvantages admirably adapted to preſerve the juſt equilibrium of happineſs. This we may confidently aſſert, that, whatever are the inconveniences of any of them, they are all preferable to a life of inaction; to that wretched liſtleſſneſs, which is conſtrained to purſue pleaſure as a buſineſs, and by rendering it the object of ſevere and unvaried attention, deſtroys its very eſſence."

Among the Romaniſts profeſſion denotes the entering into a religious order, whereby a perſon offers himſelf to God by a vow of inviolably obſerving obedience, chaſtity, and poverty.

PROFESSOR, in the univerſities, a perſon who teaches or reads public lectures in ſome art or ſcience from a chair for the purpoſe.

PROFILE, in architecture, the draught of a building, fortification, &c. wherein are expreſſed the ſeveral heights, widths, and thickneſſes, ſuch as they would appear were the building cut down perpendicularly from the roof to the foundation. Whence the profile is alſo called the *ſection*, ſometimes *orthographical ſection*, and by Vitruvius alſo *ſciagraphy*.

Profile, in this ſenſe, amounts to the ſame with *elevation*; and ſtands oppoſed to a *plan* or *ichnography*.

PROFILE is alſo uſed for the contour or out-line of a figure, building, member of architecture, or the like; as a baſe, a cornice, &c. Hence *profiling* is ſometimes uſed for deſigning, or deſcribing the member with rule, compaſs, &c.

PROFILE, in ſculpture and painting.—A head, a portrait, &c. are ſaid to be in *profile*, when they are repreſented ſidewiſe, or in a ſide-view; as, when in a portrait there is but one ſide of the face, one eye, one cheek, &c. ſhown, and nothing of the other.—On almoſt all medals, the faces are repreſented in *profile*.

PROFLUVIUM, in medicine, denotes a flux, or liquid evacuation of any thing.

PROGNOSTIC, among phyſicians, ſignifies a judgement concerning the event of a diſeaſe, as whether it ſhall end in life or death, be ſhort or long, mild or malignant, &c.

Programma. **PROGRAMMA**, anciently ſignified a letter ſealed with the king's ſeal.

Programma is alſo an univerſity term for a billet or advertiſement, poſted up or given into the hand, by way of invitation to an oration, &c. containing the argument, or ſo much as is neceſſary for underſtanding thereof.

Progreſſion. **PROGRESSION**, in general, denotes a regular advancing, or going forward, in the ſame courſe and manner.

Progression, in mathematics, is either arithmetical or geometrical. Continued arithmetic proportion is, where the terms do increaſe and decreaſe by equal differences, and is called *arithmetic progreſſion :*

$$\text{Thus}\left\{\begin{array}{l} a,\ a+d,\ a+2d,\ a+3d,\ \text{\&c. increaſing} \\ a,\ a-d,\ a-2d,\ a-3d,\ \text{\&c. decreaſing} \end{array}\right\}\text{by the difference } d.$$

$$\text{In numbers}\left\{\begin{array}{l} 2,\ 4,\ 6,\ 8,\ 10,\ \text{\&c. increaſing} \\ 10,\ 8,\ 6,\ 4,\ 2,\ \text{\&c. decreaſing} \end{array}\right\}\text{by the difference 2.}$$

Geometric Progreſſion, or *Continued Geometric Proportion*, is when the terms do increaſe or decreaſe by equal ratios : thus,

$$\left.\begin{array}{r} a,\ ar,\ arr,\ arrr,\ \text{\&c. increaſing} \\ a,\ \frac{a}{r},\ \frac{a}{rr},\ \frac{a}{rrr},\ \text{\&c. decreaſing} \end{array}\right\}\text{from a continual}\left\{\begin{array}{l}\text{multiplication} \\ \text{diviſion}\end{array}\right\}\text{by } r.$$

$$\left.\begin{array}{r} 2,\ 4,\ 8,\ 16,\ 32,\ 64,\ \text{increaſing} \\ 64,\ 32,\ 16,\ 8,\ 4,\ 2,\ \text{decreaſing} \end{array}\right\}\text{from a continual}\left\{\begin{array}{l}\text{multiplication} \\ \text{diviſion}\end{array}\right\}\text{by 2.}$$

See the article Fluxions, Geometry, and Series.

PROJECTILES.

1 Object of the ſcience. THIS is the name for that part of mechanical philoſophy which treats of the motion of bodies any how projected from the ſurface of this earth, and influenced by the action of terreſtrial gravity.

2 Effect of gravity on projected bodies. It is demonſtrated in the phyſical part of aſtronomy that a body ſo projected muſt deſcribe a conic ſection, having the centre of the earth in one focus ; and that it will deſcribe round that focus areas proportional to the times. And it follows from the principles of that ſcience, that if the velocity of projection exceeds 36700 feet in a ſecond, the body (if not reſiſted by the air) would deſcribe a hyperbola ; if it be juſt 36700, it would deſcribe a parabola ; and if it be leſs than this, it would deſcribe an ellipſis. If projected directly upwards, in the firſt caſe, it would never return, but proceed for ever ; its velocity continually diminiſhing, but never becoming leſs than an aſſignable portion of the exceſs of the initial velocity above 36700 feet in a ſecond ; in the ſecond caſe, it would never return, its velocity would diminiſh without end, but never be extinguiſhed. In the third caſe, it would proceed till its velocity was reduced to an aſſignable portion of the difference between 36700 and its initial velocity ; and would then return, regaining its velocity by the ſame degrees, and in the ſame places, as it loſt it. Theſe are neceſſary conſequences of a gravity directed to the centre of the earth, and inverſely proportional to the ſquare of the diſtance. But in the greateſt projections that we are able to make, the gravitations are ſo nearly equal, and in directions ſo nearly parallel, that it would be ridiculous affectation to pay any regard to the deviations from equality and paralleliſm. A bullet riſing a mile above the ſurface of the earth loſes only $\frac{1}{2000}$ of its weight, and a horizontal range of 4 miles makes only 4 of deviation from paralleliſm.

Let us therefore aſſume gravitation as equal and parallel. The errors ariſing from this aſſumption are quite inſenſible in all the uſes which can be made of this theory.

The theory itſelf will ever be regarded with ſome veneration and affection by the learned. It was the firſt fruits of mathematical philoſophy. Galileo was the firſt who applied mathematical knowledge to the motions of free bodies, and this was the ſubject on which he exerciſed his fine genius.

3 Conſtant or uniform. Gravity muſt be conſidered by us as a conſtant or uniform accelerating or retarding force, according as it produces the deſcent, or retards the aſcent, of a body. A conſtant or invariable accelerating force is one which produces an uniform acceleration ; that is, which in equal times produces equal increments of velocity, and therefore produces increments of velocity proportional to the times in which they are produced. Forces are of themſelves imperceptible, and are ſeen only in their effects ; and they have no meaſure but the effect, or what *meaſures* the effect ; and every thing which we can diſcover with regard to thoſe meaſures, we muſt affirm with regard to the things of which we aſſume them as the meaſures. Therefore,

4 Conſequences of this fact. The motion of a falling body, or of a body projected directly downwards, is uniformly accelerated ; and that of a body projected directly upwards is uniformly retarded : that is, the acquired velocities are as the times in which they are acquired by falling, and the extinguiſhed velocities are as the times in which they are extinguiſhed.

5 Corollaries drawn from it. *Cor.* 1. If bodies ſimply fall, not being projected downwards by any external force, the times of the falls are proportional to the final velocities ; and the times of aſcents, which terminate by the action of gravity alone, are proportional to the initial velocities.

2. The ſpaces deſcribed by a heavy body falling from reſt are as the ſquares of the acquired velocities ; and the differences of theſe ſpaces are as the differences of the ſquares of the acquired velocities : and, on the other hand, the heights to which bodies projected upwards will riſe, before their motions be extinguiſhed, are as the ſquares of the initial velocities.

3. The ſpaces deſcribed by falling bodies are proportional to the ſquares of the times from the beginning of the fall ; and the ſpaces deſcribed by bodies projected directly upwards are as the ſquares of the times of the aſcents.

4. The ſpace deſcribed by a body falling from reſt is one half of the ſpace which the body would have uniformly deſcribed in the ſame time, with the velocity ac-

quired by the fall.—And the height to which a body will riſe, in oppoſition to the action of gravity, is one half of the ſpace which it would uniformly deſcribe in the ſame time with the initial velocity.

In like manner the difference of the ſpaces which a falling or riſing body deſcribes in any equal ſucceſſive parts of its fall or riſe, is one half of the ſpace which it would uniformly deſcribe in the ſame time with the difference of the initial and final velocities.

This propoſition will be more conveniently expreſſed for our purpoſe thus:

A body moving uniformly during the time of any fall with the velocity acquired thereby, will in that time deſcribe a ſpace double of that fall; and a body projected directly upwards will riſe to a height which is one half of the ſpace which it would, uniformly continued, deſcribe in the time of its aſcent with the initial velocity of projection.

Theſe theorems have been already demonſtrated in a popular way, in the article Mechanics, ſect. vi. § 14, 15, 16, &c. and in Gunnery. But we would recommend to our readers the 39th prop. of the firſt book of Newton's *Principia*, as giving the moſt general inveſtigation of this ſubject; equally eaſy with theſe more looſe methods of demonſtration, and infinitely ſuperior to them, by being equally applicable to every variation of the accelerating force. See an excellent application of this propoſition by Mr Robins, for defining the motion of a ball diſcharged from a cannon, in the article Gunnery, n° 15. See another in Optics, n° 127. for defining the motion of light in refraction, &c.

6
The force of gravity in falling bodies can be aſcertained.

5. It is a matter of obſervation and experience, that a heavy body falls 16 feet and an inch Engliſh meaſure in a ſecond of time; and therefore acquires the velocity of 32 feet 2 inches *per* ſecond. This cannot be aſcertained directly, with the preciſion that is neceſſary. A ſecond is too ſmall a portion of time to be exactly meaſured and compared with the ſpace deſcribed; but it is done with the greateſt accuracy by comparing the motion of a falling body with that of a pendulum. The time of a vibration is to the time of falling through half the length of the pendulum, as the circumference of a circle is to its diameter. The length of a pendulum can be aſcertained with great preciſion; and it can be lengthened or ſhortened till it makes juſt 86,400 vibrations in a day: and this is the way in which the ſpace fallen through in a ſecond has been accurately aſcertained.

As all other forces are aſcertained by the accelerations which they produce, they are conveniently meaſured by comparing their accelerations with the acceleration of gravity. This therefore has been aſſumed by all the later and beſt writers on mechanical philoſophy, as the unit by which every other force is meaſured. It gives us a perfectly diſtinct notion of the force which retains the moon in its orbit, when we ſay it is the 3600th part of the weight of the moon at the ſurface of the earth. We mean by this, that if a bullet were here weighed by a ſpring ſteel-yard, and pulled it out to the mark 3600; it it were then taken to the diſtance of the moon, it would pull it out only to the mark 1. And we make this aſſertion on the authority of our having obſerved that a body at the diſtance of the moon falls from that diſtance $\frac{1}{3600}$ part of 16 feet in a ſecond. We do not, therefore, compare the *forces*, which are imperceptible things; we compare the accelerations, which are their indications, effects, and meaſures.

7
Two modes of determining the fall of heavy bodies.

This has made philoſophers ſo anxious to determine with preciſion the fall of heavy bodies, in order to have an exact value of the accelerating power of terreſtrial gravity. Now we muſt here obſerve, that this meaſure may be taken in two ways: we may take the ſpace through which the heavy body falls in a ſecond; or we may take the velocity which it acquires in conſequence of gravity having acted on it during a ſecond. The laſt is the proper meaſure; for the laſt is the immediate effect on the body. The action of gravity has changed the ſtate of the body—in what way? by giving it a determination to motion downward: this both points out the kind and the degree or intenſity of the force of gravity. The ſpace deſcribed in a ſecond by falling, is not an invariable meaſure; for, in the ſucceſſive ſeconds, the body falls through 16, 48, 80, 112, &c. feet, but the changes of the body's ſtate in each ſecond is the ſame. At the beginning it had no determination to move with any appreciable velocity; at the end of the firſt ſecond it had a determination by which it would have gone on for ever (had no ſubſequent force acted on it) at the rate of 32 feet *per* ſecond. At the end of the ſecond ſecond, it had a determination by which it would have moved for ever, at the rate of 64 feet *per* ſecond. At the end of the third ſecond, it had a determination by which it would have moved for ever, at the rate of 96 feet *per* ſecond, &c. &c. The difference of theſe determinations is a determination to the rate of 32 feet *per* ſecond. This is therefore conſtant, and the indication and proper meaſure of the conſtant or invariable force of gravity. The ſpace fallen through in the firſt ſecond is of uſe only as it is one half of the meaſure of this determination; and as halves have the proportion of their wholes, different accelerating forces may be ſafely affirmed to be in the proportion of the ſpaces through which they uniformly impel bodies in the ſame time. But we ſhould always recollect, that this is but one half of the true meaſure of the accelerating force. Mathematicians of the firſt rank have committed great miſtakes by not attending to this; and it is neceſſary to notice it juſt now, becauſe caſes will occur in the proſecution of this ſubject, where we ſhall be very apt to confound our reaſonings by a confuſion in the uſe of thoſe meaſures. Thoſe mathematicians who are accuſtomed to the geometrical conſideration of curvilineal motions, are generally diſpoſed to take the *actual deflection* from the tangent as the meaſure of the deflecting force; while thoſe who treat the ſame ſubject algebraically, by the aſſiſtance of fluxions, take *the change of velocity*, which is meaſured by *twice* the deflection. The reaſon is this: when a body paſſes through the point B of a curve ABC, fig. 1. if the deflecting force were to ceaſe at that inſtant, the body would deſcribe the tangent BD in the ſame time in which it deſcribes the arch BC of the curve, and DC is the deflection, and is therefore taken for the meaſure of the deflecting force. But the algebraiſt is accuſtomed to conſider the curve by means of an equation between the abſciſſæ H*a*, H*b*, H*c*, and their reſpective ordinates A*a*, B*b*, C*c*; and he meaſures the deflections by the changes made on the increments of the ordinates. Thus the increment of the ordinate A*a*, while the body deſcribes the arch AB of the curve, is BG. If the deflecting force were to ceaſe

8
Miſtakes of mathematicians on this ſubject;

Plate CCCXVII.

ceaſe when the body is at B, the next increment would have been equal to BG, that is, it would have been EF; but, in conſequence of the deflection, it is only CF: therefore he takes EC for the meaſure of the deflection, and of the deflecting force. Now EC is ultimately twice DC; and thus the meaſure of the algebraiſt (derived ſolely from the nature of the differential method, and without any regard to phyſical conſiderations) happens to coincide with the true phyſical meaſure. There is therefore great danger of mixing theſe meaſures.

9 Particularly of Leibnitz.

Of this we cannot give a more remarkable inſtance than Leibnitz's attempt to demonſtrate the elliptical motion of the planets in the Leipſic Acts, 1689. He firſt conſiders the ſubject mechanically, and takes the deflection or DC for the meaſure of the deflecting force. He then introduces his differential calculus, where he takes the difference of the increments for the meaſure; and thus brings himſelf into a confuſion, which luckily compenſates for the falſe reaſoning in the preceding part of his paper, and gives his reſult the appearance of a demonſtration of Newton's great diſcovery, while, in fact, it is a confuſed jumble of aſſumptions, ſelf-contradictory, and inconſiſtent with the very laws of mechanics which are uſed by him in the inveſtigation. Seventeen years after this, in 1706, having been criticiſed for his bad reaſoning, or rather accuſed of an envious and unſucceſsful attempt to appropriate Newton's inventions to himſelf, he gives a correction of his paralogiſm, which he calls a correction of language. But he either had not obſerved where the paralogiſm lay, or would not let himſelf down by acknowledging a miſtake in what he wiſhed the world to think his own calculus (fluxions); he applied the correction where no fault had been committed, for he had meaſured both the centrifugal force and the ſolicitation of gravity in the ſame way, but had applied the fluxionary expreſſion to the laſt and not to the firſt, and, by ſo doing, he completely deſtroyed all coincidence between his reſult and the planetary motions. We mention this inſtance, not only as a caution to our mathematical readers, but alſo as a very curious literary anecdote. This diſſertation of Leibnitz is one of the moſt obſcure of his obſcure writings, but deſerves the attention of an intelligent and curious reader, and cannot fail of making an indelible impreſſion on his mind, with relation to the modeſty, candour, and probity of the author. It is preceded by a diſſertation on the ſubject which we are now entering upon, the motion of projectiles in a reſiſting medium. Newton's *Principia* had been publiſhed a few years before, and had been reviewed, in a manner ſhamefully ſlight, in the Leipſic Acts. Both theſe ſubjects make the capital articles of that immortal work. Mr Leibnitz publiſhed theſe diſſertations, without (ſays he) having ſeen Newton's book, in order to ſhow the world that he had, ſome years before, diſcovered the ſame theorems. Mr Nicholas Fatio carried a copy of the *Principia* from the author to Hanover in 1686, where he expected to find Mr Leibnitz; he was then abſent, but Fatio ſaw him often before his return to France in 1687, and does not ſay that the book was not given him. Read along with theſe diſſertations Dr Keill's letter to John Bernoulli and others, publiſhed in the *Journal Literaire de la Hayée* 1714, and to John Bernoulli in 1719.

10 Newton accuſed of a ſimilar miſtake by J. Bernoulli,

Newton has been accuſed of a ſimilar overſight by John Bernoulli, (who indeed calls it a miſtake in principle) in his Propoſition X. Book 2, on the very ſubject we are now conſidering. But Dr Keill has ſhown it to be only an overſight, in drawing the tangent on the wrong ſide of the ordinate. For in this very propoſition Newton exhibits, in the ſtricteſt and moſt beautiful manner, the difference between the geometrical and algebraical manner of conſidering the ſubject; and expreſsly warns the reader, that *his* algebraical ſymbol expreſſes the deflection only, and not the variation of the increment of the ordinate.

11 But falſely.

It is therefore in the laſt degree improbable that he would make this miſtake. He moſt expreſsly does not; and as to the real miſtake, which he corrected in the ſecond edition, the writer of this article has in his poſſeſſion a manuſcript copy of notes and illuſtrations on the whole Principia, written in 1693 by Dr David Gregory, Savilian profeſſor of aſtronomy at Oxford, at the deſire of Mr Newton, as preparatory for a new edition, where he has rectified this and ſeveral other miſtakes in that work, and ſays that Mr Newton had ſeen and approved of the amendments.

12 Inſincerity of Bernoulli with reſpect to Newton.

We mention theſe particulars, becauſe Mr Bernoulli publiſhed an elegant diſſertation on this ſubject in the Leipſic Acts in 1713; in which he charges Newton (though with many proteſtations of admiration and reſpect) with this miſtake in principle; and ſays, that he communicated his correction to Mr Newton by his nephew Nicholas Bernoulli, that it might be corrected in the new edition, which he heard was in the preſs. And he afterwards adds, that it appears by ſome ſheets being cancelled, and new ones ſubſtituted in this part of the work, that the miſtake would have continued, had he not corrected it. We would deſire our readers to conſult this diſſertation, which is extremely elegant, and will be of ſervice to us in this article; and let them compare the civil things which is here ſaid of the *vir incomparabilis*, the *omni laude major*, the *ſummus Newtonus*, with what the ſame author, in the ſame year, in the Leipſic Acts, but under a borrowed name, ſays of him. Our readers will have no heſitation in aſcribing this letter to this author. For, after praiſing John Bernoulli as *ſummus geometra, natus ad ſummorum geometrarum paralogiſmos corrigendos, ſummi candoris ut et modeſtiæ*, he betrays himſelf by an unguarded warmth, when defending J. B.'s demonſtration of the inverſe problem of centripetal forces, by calling it MEAM *demonſtrationem*.

Let our readers now conſider the ſcope and intention of this diſſertation on projectiles, and judge whether the author's aim was to inſtruct the world, or to acquire fame, by correcting Newton. The diſſertation does not contain one theorem, one corollary, nor one ſtep of argument, which is not to be found in Newton's firſt edition; nor has he gone farther than Newton's ſingle propoſition the Xth. To us it appears an exact companion to his propoſition on centripetal forces, which he boaſts of having firſt demonſtrated, although it is in every ſtep a tranſcript of the 42d of the 1ſt Book of Newton's Principia, the geometrical language of Newton being changed into algebraic, as he has in the preſent caſe changed Newton's algebraic analyſis into a very elegant geometrical one.

We hope to be forgiven for this long digreſſion. It is a very curious piece of literary hiſtory, and ſhows the combination which envy and want of honourable principle had formed againſt the reputation of our illuſtrious countryman; and we think it our duty to embrace any opportunity of doing it juſtice.—To return to our ſubject:

13
Accurate meaſure of the accelerative power of gravity.

The accurate meaſure of the accelerative power of gravity, is the *fall* $16\frac{1}{12}$ feet, if we meaſure it by the ſpace, or the *velocity* of $32\frac{1}{6}$ feet per ſecond, if we take the velocity. It will greatly facilitate calculation, and will be ſufficiently exact for all our purpoſes, if we take 16 and 32, ſuppoſing that a body falls 16 feet in a ſecond, and acquires the velocity of 32 feet per ſecond. Then, becauſe the heights are as the ſquares of the times, and as the ſquares of the acquired velocities, a body will fall one foot in one fourth of a ſecond, and will acquire the velocity of eight feet per ſecond. Now let h expreſs the height in feet, and call it the PRODUCING HEIGHT; v the velocity in feet per ſecond, and call it the PRODUCED VELOCITY, the velocity DUE; and t the time in ſeconds.—We ſhall have the following formulæ, which are of eaſy recollection, and will ſerve, without tables, to anſwer all the queſtions relative to projectiles.

14
General formulæ deduced.

$$\text{I. } v = 8\sqrt{h}, = 8 \times 4t, = 32t$$

$$\text{II. } t = \frac{\sqrt{h}}{4}, = \frac{v}{32}$$

$$\text{III. } \sqrt{h} = \frac{v}{8}, = 4t$$

$$\text{IV. } h = \frac{v^2}{64}, = 16t^2$$

15
Examples of their uſe in falling bodies.

To give ſome examples of their uſe, let it be required,

1. To find the time of falling through 256 feet. Here $h = 256$, $\sqrt{256} = 16$, and $\frac{16}{4} = 4$. Anſwer 4″.

2. To find the velocity acquired by falling four ſeconds. $t = 4 . 32 \times 4 = 128$ feet per ſecond.

3. To find the velocity acquired by falling 625 feet. $h = 625 . \sqrt{h} = 25 . 8\sqrt{h} = 2000$ feet per ſecond.

16
In bodies projected upwards.

4. To find the height to which a body will riſe when projected with the velocity of 56 feet per ſecond, or the height through which a body muſt fall to acquire this velocity.

$$v = 56 . \frac{56}{8} = 7, = \sqrt{h} . 7^2 = h, = 49 \text{ feet.}$$

$$\text{or } 56^2 = 3136 . \frac{3136}{64} = 49 \text{ feet.}$$

17
And directly downwards.

5. Suppoſe a body projected directly downwards with the velocity of 10 feet per ſecond; what will be its velocity after four ſeconds? In four ſeconds it will have acquired, by the action of gravity, the velocity of 4×32, or 128 feet, and therefore its whole velocity will be 138 feet per ſecond.

6. To find how far it will have moved, compound its motion of projection, which will be 40 feet in four ſeconds, with the motion which gravity alone would have given it in that time, which is 256 feet; and the whole motion will be 296 feet.

7. Suppoſe the body projected as already mentioned, and that it is required to determine the time it will take to go 296 feet downwards, and the velocity it will have acquired.

Find the height x, through which it muſt fall to acquire the velocity of projection, 10 feet, and the time y of falling from this height. Then find the time z of falling through the height $296 + x$, and the velocity v acquired by this fall. The time of deſcribing the 296 feet will be $z - y$, and v is the velocity required.

From ſuch examples, it is eaſy to ſee the way of anſwering every queſtion of the kind.

18
More general formulæ.

Writers on the higher parts of mechanics always compute the actions of other accelerating and retarding forces by comparing them with the acceleration of gravity, and in order to render their expreſſions more general, uſe a ſymbol, ſuch as g for gravity, leaving the reader to convert it into numbers. Agreeably to this view, the general formulæ will ſtand thus:

$$\text{I. } v = \sqrt{2gh}, \text{ i. e. } \sqrt{2}\sqrt{g}\sqrt{h}, = g\ \overline{t},$$

$$\text{II. } t = \frac{v}{g}, = \frac{\sqrt{4h}}{\sqrt{2g}}, = \sqrt{\frac{4h}{2g}}, = \sqrt{\frac{2h}{g}}$$

$$\text{IIII. } h = \frac{v^2}{2g}, = \frac{gt^2}{2}$$

In all theſe equations, gravity, or its accelerating power, is eſtimated, as it ought to be, by the change of velocity which it generates in a particle of matter in an unit of time. But many mathematicians, in their inveſtigations of curvilineal and other varied motions, meaſure it by the deflection which it produces in this time from the tangent of the curve, or by the increment by which the ſpace deſcribed in an unit of time exceeds the ſpace deſcribed in the preceding unit. This is but one half of the increment which gravity would have produced, had the body moved through the whole moment with the acquired addition of velocity. In this ſenſe of the ſymbol g, the equations ſtand thus:

$$\text{I. } v = 2\sqrt{gh}, = 2gt$$

$$\text{II. } t = \sqrt{\frac{h}{g}}, = \frac{v}{2g}$$

$$\text{IV. } h = \frac{v^2}{4g}, = gt^2, \text{ and } \sqrt{h} = \frac{v}{2\sqrt{g}}$$

It is alſo very uſual to conſider the accelerating force of gravity as the unit of compariſon. This renders the expreſſions much more ſimple. In this way, v expreſſes not the velocity, but the height neceſſary for acquiring it, and the velocity itſelf is expreſſed by $\sqrt{v}$. To reduce ſuch an expreſſion of a velocity to numbers, we muſt multiply it by $\sqrt{2g}$, or by $2\sqrt{g}$, according as we make g to be the generated velocity, or the ſpace fallen through in the unit of time.

19
Bodies projected obliquely.

This will ſuffice for the perpendicular aſcents or deſcents of heavy bodies, and we proceed to conſider their motions when projected obliquely. The circumſtance which renders this an intereſting ſubject, is, that the flight of cannon ſhot and ſhells are inſtances of ſuch motion, and the art of gunnery muſt in a great meaſure depend on this doctrine.

Let a body B (fig. 2.), be projected in any direction BC, not perpendicular to the horizon, and with any velocity. Let AB be the height producing this velocity; that is, let the velocity be that which a heavy body would acquire by falling freely through AB. It is required to determine the path of the body, and all the circumſtances of its motion in this path?

Plate CCCCXVI

1. It is evident, that by the continual action of gravity,

vity, the body will be continually deflected from the line BC, and will deſcribe a curve line BVG, concave towards the earth.

20 Deſcribes a parabola.

2. This curve line is a parabola, of which the vertical line ABE is a diameter, B the vertex of this diameter, and BC a tangent in B.

Through any two points V, G of the curve draw VC, GH parallel to AB, meeting BC in C and H, and draw VE, GK parallel to BC, meeting AB in E, K. It follows, from the compoſition of motions, that the body would arrive at the points V, G of the curve in the ſame time that it would have uniformly deſcribed BC, BH, with the velocity of projection; or that it would have fallen through BE, BK, with a motion uniformly accelerated by gravity; therefore the times of deſcribing BC, BH, uniformly, are the ſame with the times of falling through BE, BK. But, becauſe the motion along BH is uniform, BC is to BH as the time of deſcribing BC to the time of deſcribing BH, which we may expreſs thus, $BC : BH = T, BC : T, BH, = T, BE : T, BK$. But, becauſe the motion along BK is uniformly accelerated, we have $BE : BK = T^2, BE : T^2, BK, = BC^2 : BH^2, = EV^2 : KG^2$; therefore the curve BVG is ſuch, that the abſciſſæ BE, BK are as the ſquares of the correſponding ordinates EV, KG; that is, the curve BVG is a parabola, and BC, parallel to the ordinates, is a tangent in the point B.

3. If through the point A there be drawn the horizontal line AD *d*, it is the directrix of the parabola.

Let BE be taken equal to AB. The time of falling through BE is equal to the time of falling through AB; But BC is deſcribed with the velocity acquired by falling through AB: and therefore by n° 4. of perpendicular deſcents, BC is double of AB, and EV is double of BE; therefore $EV^2 = 4\,BE^2, = 4\,BE \times AB, = BE \times 4\,AB$, and 4 AB is the parameter or *latus rectum* of the parabola BVG, and AB being one-fourth of the parameter, AD is the directrix.

4. The times of deſcribing the different arches BV, VG of the parabola are as the portions BC, BH of the tangent, or as the portions AD, A*d* of the directrix, intercepted by the ſame vertical lines AB, CV, HG; for the times of deſcribing BV, BVG are the ſame with thoſe of deſcribing the correſponding parts BC, BH of the tangent, and are proportional to theſe parts, becauſe the motion along BH is uniform; and BC, BH are proportional to AD, A*d*.

Therefore the motion eſtimated horizontally is uniform.

5. The velocity in any point G of the curve is the ſame with that which a heavy body would acquire by falling from the directrix along *d*G. Draw the tangent GT, cutting the vertical AB in T; take the points *a*, *f*, equidiſtant from A and *d*, and extremely near them, and draw the verticals *ab*, *fg*; let the points *a*, *f*, continually approach A and *d*, and ultimately coincide with them. It is evident that B*b* will ultimately be to *g*G, in the ratio of the velocity at B to the velocity at G; for the portions of the tangent ultimately coincide with the portions of the curve, and are deſcribed in equal times; but B*b* is to *g*G as BH to TG: therefore the velocity at B is to that at G as BH to TG. But, by the properties of the parabola, BH^2 is to TG^2 as AB to *d*G; and AB is to *d*G as the ſquare of the velocity acquired by falling through AB to the ſquare of the velocity acquired by falling through *d*G; and the velocity in BH, or in the point B of the parabola, is the velocity acquired by falling along AB; therefore the velocity in TG, or in the point G of the parabola, is the velocity acquired by falling along *d*G.

21 The parabolic theory ingenious, but of little uſe in practice.

Theſe few ſimple propoſitions contain all the theory of the motion of projectiles in vacuo, or independent on the reſiſtance of the air; and being a very eaſy and neat piece of mathematical philoſophy, and connected with very intereſting practice, and a very reſpectable profeſſion, they have been much commented on, and have furniſhed matter for many ſplendid volumes. But the air's reſiſtance occaſions ſuch a prodigious diminution of motion in the great velocities of military projectiles, that this parabolic theory, as it is called, is hardly of any uſe. A muſket-ball, diſcharged with the ordinary allotment of powder, iſſues from the piece with the velocity of 1670 feet per ſecond: this velocity would be acquired by falling from the height of eight miles. If the piece be elevated to an angle of 45°, the parabola ſhould be of ſuch extent that it would reach 16 miles on the horizontal plain; whereas it does not reach much above half a mile. Similar deficiencies are obſerved in the ranges of cannon ſhot.

22 A ſhort view of it.

We do not propoſe, therefore, to dwell much on this theory, and ſhall only give ſuch a ſynoptical view of it as ſhall make our readers underſtand the more general circumſtances of the theory, and be maſters of the language of the art.

Plate CCCCXVII.

Let OB (fig. 3.) be a vertical line. About the centres A and B, with the diſtance AB, deſcribe the ſemicircles ODB, AHK, and with the axis AB, and ſemiaxis GE, equal to AB, deſcribe the ſemi-ellipſe AEB: with the focus B, vertex A, diameter AB, and tangent AD, parallel to the horizon, deſcribe the parabola APS.

Let a body be projected from B, in any direction BC, with the velocity acquired by falling through AB. By what has already been demonſtrated, it will deſcribe a parabola BVPM. Then,

1. ADL parallel to the horizon is the directrix of every parabola which can be deſcribed by a body projected from B with this velocity. This is evident.

2. The ſemicircle AHK is the locus of all the foci of theſe parabolas: For the diſtance BH of a point B of any parabola from the directrix AD is equal to its diſtance BF from the focus F of that parabola; therefore the foci of all the parabolas which paſs through B, and have AD for their directrix, muſt be in the circumference of the circle which has AB for its radius, and B for its centre.

3. If the line of direction BC cut the upper ſemicircle in C, and the vertical line CF be drawn, cutting the lower ſemicircle in F, F is the focus of the parabola BVPM, deſcribed by the body which is projected in the direction BC, with the velocity acquired by falling through BA: for drawing AC, BF, it is evident that ACFB is a rhombus, and that the angle ABF is biſected by BC, and therefore the focus lies in the line BF; but it alſo lies in the circumference AFK, and therefore in F.

If C is in the upper quadrant of ODB, F is in the upper quadrant of AFK; and if C be in the lower quadrant of ODB (as when BC is the line of direction) then the focus of the correſponding parabola B *v* M is in the lower quadrant of AHK, as at *f*.

4. The ellipſis AEB is the locus of the vertex of all the parabolas, and the vertex V of any one of them BVPM is in the interſection of this ellipſis with the vertical CF: for let this vertical cut the horizontal lines AD, GE, BN, in θ, λ, N. Then it is plain that N λ is half of N θ, and λ V is half of C θ; therefore NV is half of NC, and V is the vertex of the axis.

If the focus is in the upper or lower quadrant of the circle AHK, the vertex is in the upper or the lower quadrant of the ellipſe AEG.

5. If BFP be drawn through the focus of any one of the parabolas, ſuch as BVM, cutting the parabola APS in P, the parabola BVM touches the parabola APS in P: for drawing P δ κ parallel to AB, cutting the directrix O κ of the parabola APS in κ, and the directrix AL of the parabola BVM in δ, then PB=Pκ; but BF=BA, =AO, =κ δ: therefore P δ=PF, and the point P is in the parabola BVM. Alſo the tangents to both parabolas in P coincide, for they biſect the angle κ PB; therefore the two parabolas having a common tangent, touch each other in P.

Cor. All the parabolas which can be deſcribed by a body projected from B, with the velocity acquired by falling through AB, will touch the concavity of the parabola APS, and lie wholly within it.

6. P is the moſt diſtant point of the line BP which can be hit by a body projected from B with the velocity acquired by falling through AB. For if the direction is more elevated than BC, the focus of the parabola deſcribed by the body will lie between F and A, and the parabola will touch APS in ſome point between P and A; and being wholly within the parabola APS, it muſt cut the line BP in ſome point within P. The ſame thing may be ſhown when the direction is leſs elevated than BC.

7. The parabola APS is the locus of the greateſt ranges on any planes BP, BS, &c. and no point lying without this parabola can be ſtruck.

8. The greateſt range on any plane BP is produced when the line of direction BC biſects the angle OBP formed by that plane with the vertical: for the parabola deſcribed by the body in this caſe touches APS in P, and its focus is in the line BP, and therefore the tangent BC biſects the angle OBP.

Cor. The greateſt range on a horizontal plane is made with an elevation of 45°.

9. A point M in any plane BS, lying between B and S, may be ſtruck with two directions, BC and B *c*; and theſe directions are equidiſtant from the direction B *t*, which gives the greateſt range on that plane: for if about the centre M, with the diſtance ML from the directrix AL, we deſcribe a circle LF*f*, it will cut the circle AHK in two points F and *f*, which are evidently the foci of two parabolas BVM, B *v* M, having the directrix AL and diameter ABK. The interſection of the circle ODB, with the verticals FC, *fc*, determine the directions BC, B *c* of the tangents. Draw A *t* parallel to BS, and join *t* B, C *c*, F *f*; then OB *t* $= \frac{1}{2}$ OBS, and B *t* is the direction which gives the greateſt range on the plane BS: but becauſe F *f* is a chord of the circles deſcribed round the centres B and M, F *f* is perpendicular to BM, and C *c* to A *t*, and the arches C *t*, *c t* are equal; and therefore the angles CB *t*, *c* B *t* are equal.

Thus we have given a general view of the ſubject, which ſhows the connection and dependence of every circumſtance which can influence the reſult; for it is evident that to every velocity of projection there belongs a ſet of parabolas, with their directions and ranges; and every change of velocity has a line AB correſponding to it, to which all the others are proportional. As the height neceſſary for acquiring any velocity increaſes or diminiſhes in the duplicate proportion of that velocity, it is evident that all the ranges with given elevations will vary in the ſame proportion, a double velocity giving a quadruple range, a triple velocity giving a noncuple range, &c. And, on the other hand, when the ranges are determined beforehand (which is the uſual caſe), the velocities are in the ſubduplicate proportion of the ranges. A quadruple range will require a double velocity, &c.

28 Experience principally directs the practical gunner.

On the principles now eſtabliſhed is founded the ordinary theory of gunnery, furniſhing rules which are to direct the art of throwing ſhot and ſhells, ſo as to hit the mark with a determined velocity.

But we muſt obſerve, that this theory is of little ſervice for directing us in the practice of cannonading. Here it is neceſſary to come as near as we can to the object aimed at, and the hurry of ſervice allows no time for geometrical methods of pointing the piece after each diſcharge. The gunner either points the cannon directly to the object, when within 200 or 300 yards of it, in which caſe he is ſaid to ſhoot point blank (*pointer au blanc*, i. e. at the white mark in the middle of the gunners target); or, if at a greater diſtance, he eſtimates to the beſt of his judgment the deflection correſponding to his diſtance, and points the cannon accordingly. In this he is aided by the greater thickneſs at the breech of a piece of ordnance. Or, laſtly, when the intention is not to batter, but to rake along a line occupied by the enemy, the cannon is elevated at a conſiderable angle, and the ſhot diſcharged with a ſmall force, ſo that it drops into the enemy's poſt, and bounds along the line. In all theſe ſervices the gunner is directed entirely by trial, and we cannot ſay that this parabolic theory can do him any ſervice.

The principal uſe of it is to direct the bombardier in throwing ſhells. With theſe it is propoſed to break down or ſet fire to buildings, to break through the vaulted roofs of magazines, or to intimidate and kill troops by burſting among them. Theſe objects are always under cover of the enemy's works, and cannot be touched by a direct ſhot. The bombs and carcaſes are therefore thrown upwards, ſo as to get over the defences and produce their effect.

Theſe ſhells are of very great weight, frequently exceeding 200 lbs. The mortars from which they are diſcharged muſt therefore be very ſtrong, that they may reſiſt the exploſion of gunpowder which is neceſſary for throwing ſuch a maſs of matter to a diſtance; they are conſequently unwieldy, and it is found moſt convenient to make them almoſt a ſolid and immoveable lump. Very little change can be made in their elevation, and therefore their ranges are regulated by the velocities given to the ſhell. Theſe again are produced by the quantities of powder in the charge; and experience (confirming the beſt theoretical notions that we can form of the ſubject) has taught us, that the ranges are nearly proportional to the quantities of powder employed, only not increaſing quite ſo faſt. This method is much eaſier than by differences of elevation; for we can ſelect the elevation which gives the greateſt range on the given plane, and then we are certain that we are employing the ſmalleſt quantity of powder with which the ſervice can be performed: and we have another advantage, that the deviations which unavoidable cauſes produce in the real directions of the bomb will then produce the ſmalleſt poſſible deviation from the intended range. This is the caſe in moſt mathematical maxima.

24
The moving force in theory different from that in practice.

In military projectiles the velocity is produced by the exploſion of a quantity of gunpowder: but in our theory it is conceived as produced by a fall from a certain height, by the proportions of which we can accurately determine its quantity. Thus a velocity of 1600 feet per ſecond is produced by a fall from the height of 40,000 feet or 1333 yards.

Plate cccxvii.

The height CA (fig. 4.) for producing the velocity of projection is called, in the language of gunnery, the IMPETUS. We ſhall expreſs it by the ſymbol h.

The diſtance AB to which the ſhell goes on any plane AB, is called the AMPLITUDE or the RANGE r.

The angle DBA, made by the vertical line and the plane AB, may be called the angle of POSITION of that plane, p.

The angle DAB, made by the axis or direction of the piece, and the direction of the object, may be called the angle of ELEVATION of the piece above the plane AB, e.

The angle ZAD, made by the vertical line, and the direction of the piece, may be called the ZENITH diſtance, z.

25
Relations between the velocity, diſtance, &c.

The relations between all the circumſtances of velocity, diſtance, poſition, elevation, and time, may be included in the following propoſitions.

I. Let a ſhell be projected from A, with the velocity acquired by falling through CA, with the intention of hitting the mark B ſituated in the given line AB.

Make ZA=4AC, and draw BD perpendicular to the horizon. Deſcribe on ZA an arch of a circle ZDA, containing an angle equal to DBA, and draw AD to the interſection of this circle with DB; then will a body projected from A, in the direction AD, with the velocity acquired by falling through CA, hit the mark B.

For, produce CA downwards, and draw BF parallel to AD, and draw ZD. It is evident from the conſtruction that AB touches the circle in B, and that the angles ADZ, DBA, are equal, as alſo the angles AZD, DAB; therefore the triangles ZAD, ADB are ſimilar.

$$\text{Therefore } BD : DA = DA : AZ,$$
$$\text{And } DA^2 = BD \times AZ;$$
$$\text{Therefore } BF^2 = AF \times AZ, = AF \times 4\ AC.$$

Therefore a parabola, of which AF is a diameter, and AZ its parameter, will paſs through B, and this parabola will be the path of the ſhell projected as already mentioned.

Remark. When BD cuts this circle, it cuts it in two points D, d; and there are two directions which will ſolve the problem. If B D′ only touches the circle in D′, there is but one direction, and AB′ is the greateſt poſſible range with this velocicity. If the vertical line through B does not meet the circle, the problem is impoſſible, the velocity being too ſmall. When B′D′ touches the circle, the two directions AD′ and A d' coaleſce into one direction, producing the greateſt range, and biſecting the angle ZAB; and the other two directions AD, Ad, producing the ſame range AB, are equidiſtant from AD′, agreeably to the general propoſition.

$$\text{It is evident that } AZ : AD = S,ADZ : S,AZD, = S,DBA : S,DAB, = S,p : S,e$$
$$\text{And } AD : DB = S,DBA : S,DAB, = S,p : S,e$$
$$\text{And } DB : AB = S,DAB : S,ADB, = S,e : S,z$$
$$\text{Therefore } AZ : AB = S^2,p \times S^2,e : S^2,e \times S,z ; = S^2,p : S,e \times S,z$$
$$\text{Or } 4\,h : r = S^2,p : S,e \times S,z, \text{ and } 4\,h \times S,e \times S,z = r \times S^2,p$$

Hence we obtains the relations wanted.

$$\text{Thus } h = \frac{r \times S^2,p}{4S,e \times S,z}, \text{ and } r = \frac{4h \times S\ e \times S,z}{S^2,p}$$
$$\text{And } S,z = \frac{r \times S^2 p}{4h \times S,e}, \text{ and } S,e = \frac{r \times S^2,p,}{4h \times S,z},$$

26
To calculate the time of flight.

The only other circumſtance in which we are intereſted is the time of the flight. A knowledge of this is neceſſary for the bombardier, that he may cut the fuzes of his ſhells to ſuch lengths as that they may burſt at the very inſtant of their hitting the mark.

Now AB : DB = Sin, ADB : Sin, DAB, = S,z : S,e, and $DB = \frac{r \times S,e}{S,z}$. But the time of the flight is the ſame with the time of falling through DB, and 16 feet : DB = 1″ : t″. Hence $t''^2 = \frac{r \times S,e}{16S,z}$, and we have the following eaſy rule.

From the ſum of the logarithms of the range, and of the ſine of elevation, ſubtract the ſum of the logarithms of 16, and of the ſine of the zenith diſtance, half the remainder is the logarithm of the time in ſeconds.

This becomes ſtill eaſier in practice; for the mortar ſhould be ſo elevated that the range is a maximum: in which caſe AB=DB, and then half the difference of the logarithms of AB and of 16 is the logarithm of the time in ſeconds.

27
The theory of gunnery compared with experiment.

Such are the deduction from the general propoſitions which conſtitute the ordinary theory of gunnery. It remains to compare them with experiment.

In ſuch experiments as can be performed with great accuracy in a chamber, the coincidence is as great as can be wiſhed. A jet of water, or mercury, gives us the fineſt example, becauſe we have the whole parabola exhibited to us in the ſimultaneous places of the ſucceeding particles. Yet even in theſe experiments a deviation can be obſerved. When the jet is made on a horizontal plane, and the curve carefully traced on a perpendicular plane held cloſe by it, it is found that the diſtance between the higheſt point of the curve and the mark is leſs than the diſtance between it and the ſpout, and that the deſcending branch of the curve is more perpendicular than the aſcending branch. And this difference is more remarkable as the jet is made with greater velocity, and reaches to a greater diſtance. This is evidently produced by the reſiſtance of the air, which diminiſhes the velocity, without affecting the gravity of the projectile. It is ſtill more ſenſible in the motion of bombs. Theſe can be traced through the air by the light of their fuzes; and we ſee that their higheſt point is always much nearer to the mark than to the mortar on a horizontal plane.

The greateſt horizontal range on this plane ſhould be when the elevation is 45°. It is always found to be much lower.

The ranges on this plane ſhould be as the ſines of twice the elevation.

A ball diſcharged at the elev. 19°. 5′ ranged 448 yards
at 9. 45 330
It ſhould have ranged by theory 241

The range at an elevation of 45° ſhould be twice the impetus. Mr Robins found that a muſket-ball, diſcharged with the uſual allotment of powder, had the velocity of 1700 feet in a ſecond. This requires a fall of 45156 feet, and the range ſhould be 90312, or 17⅛ miles; whereas it does not much exceed half a mile. A 29 pound ball diſcharged with 16 pounds of powder ſhould range about 16 miles; whereas it is generally ſhort of 3 miles.

28
This compariſon ſhews the deficiency of the theory.

Such facts ſhow incontrovertibly how deficient the parabolic theory is, and how unfit for directing the practice of the artilleriſt. A very ſimple conſideration is ſufficient for rendering this obvious to the moſt uninſtructed. The reſiſtance of the air to a very light body may greatly exceed its weight. Any one will feel this in trying to move a fan very rapidly through the air; therefore this reſiſtance would occaſion a greater deviation from uniform motion than gravity would *in that body*. Its path, therefore, through the air may differ more from a parabola than the parabola itſelf deviates from the ſtraight line.

It is for ſuch cogent reaſons that we preſume to ſay, that the voluminous treatiſes which have been publiſhed on this ſubject are nothing but ingenious amuſements for young mathematicians. Few perſons who have been much engaged in the ſtudy of mechanical philoſophy have miſſed this opportunity in the beginning of their ſtudies. The ſubject is eaſy. Some property of the parabola occurs, by which they can give a neat and ſyſtematic ſolution of all the queſtions; and at this time of ſtudy it ſeems a conſiderable eſſay of ſkill. They are tempted to write a book on the ſubject; and it finds readers among other young mechanicians, and employs all the mathematical knowledge that moſt of the young gentlemen of the military profeſſion are poſſeſſed of. But theſe performances deſerve little attention from the practical artilleriſt. All that ſeems poſſible to do for his education is, to multiply judicious experiments on real pieces of ordnance, with the charges that are uſed in actual ſervice, and to furniſh him with tables calculated from ſuch experiments.

Theſe obſervations will ſerve to juſtify us for having given ſo conciſe an account of this doctrine of the parabolic flight of bodies.

29
Cauſes of this deficiency.

But it is the buſineſs of a philoſopher to inquire into the cauſes of ſuch a prodigious deviation from a well founded theory, and having diſcovered them, to aſcertain preciſely the deviation they occaſion. Thus we ſhall obtain another theory, either in the form of the parabolic theory corrected, or as a ſubject of independent diſcuſſion. This we ſhall now attempt.

30
Effect of the atmoſphere.

The motion of projectiles is performed in the atmoſphere. The air is diſplaced, or put in motion. Whatever motion it acquires muſt be taken from the bullet. The motion communicated to the air muſt be in the proportion of the quantity of air put in motion, and of the velocity communicated to it. If, therefore, the diſplaced air be always *ſimilarly diſplaced*, whatever be the velocity of the bullet, the motion communicated to it, and loſt by the bullet, muſt be proportional to the ſquare of the velocity of the bullet and to the denſity of the air jointly. Therefore the diminution of its motion muſt be greater when the motion itſelf is greater, and in the very great velocity of ſhot and ſhells it muſt be prodigious. It appears from Mr Robins's experiments that a globe of 4½ inches in diameter, moving with the velocity of 25 feet in a ſecond, ſuſtained a reſiſtance of 315 grains, nearly ¾ of an ounce. Suppoſe this ball to move 800 feet in a ſecond, that is 32 times faſter, its reſiſtance would be 32 × 32 times ¾ of an ounce, or 768 ounces or 48 pounds. This is four times the weight of a ball of caſt iron of this diameter; and if the initial velocity had been 1600 feet per ſecond, the reſiſtance would be at leaſt 16 times the weight of the ball. It is indeed much greater than this.

31
Compared with that of gravity.

This reſiſtance, operating conſtantly and uniformly on the ball, muſt take away four times as much from its velocity as its gravity would do in the ſame time. We know that in one ſecond gravity would reduce the velocity 800 to 768 if the ball were projected ſtraight upwards. This reſiſtance of the air would therefore reduce it in one ſecond to 672, if it operated uniformly: but as the velocity diminiſhes continually by the reſiſtance, and the reſiſtance diminiſhes along with the velocity, the real diminution will be ſomewhat leſs than 128 feet. We ſhall, however, ſee afterwards that in one ſecond its velocity will be reduced from 800 to 687. From this ſimple inſtance we ſee that the reſiſtance of the air muſt occaſion great deviation from parabolic motion.

32
And conſidered as a retarding force.

In order to judge accurately of its effect, we muſt conſider it as a retarding force, in the ſame way as we conſider gravity. The weight W of a body is the aggregate of the action of the force of gravity g on each particle of the body. Suppoſe the number of equal particles, or the quantity of matter, of a body to be M, then W is equivalent to gM. In like manner, the reſiſtance R, which we obſerve in any experiment, is the aggregate of the action of a retarding force R′ on each particle, and is equivalent to R′M; and as g is equal to $\frac{W}{M}$, ſo R′ is equal to $\frac{R}{M}$. We ſhall keep this diſtinction in view, by adding the differential mark ′ to the letter R or *r*, which expreſſes the aggregate reſiſtance.

33
The reſiſtance of the air not uniform.

If we, in this manner, conſider reſiſtance as a retarding force, we can compare it with any other ſuch force by means of the retardation which it produces in ſimilar circumſtances. We would compare it with gravity by comparing the diminution of velocity which its uniform action produces in a given time with the diminution produced in the ſame time by gravity. But we have no opportunity of doing this directly; for when the reſiſtance of the air diminiſhes the velocity of a body, it diminiſhes it gradually, which occaſions a gradual diminution of its own intenſity. This is not the caſe with gravity, which has the ſame action on a body in motion or at reſt. We cannot, therefore, obſerve the uniform action of the air's reſiſtance as a retarding force. We muſt fall on ſome other way of making the compariſon. We can ſtate them both as dead preſſures. A ball may be fitted to the rod of a ſpring ſtillyard, and expoſed to the impulſe of the wind. This will compreſs the ſtillyard to the mark 3, for inſtance. Perhaps the weight of the ball will compreſs it to the mark 6. We know that half this weight would compreſs it to 3. We account this equal to the preſſure of the air, becauſe they balance the ſame elaſticity of the ſpring. And in this way we can eſtimate the reſiſtance by weights, whoſe preſſures are equal to its preſſure, and we can thus compare it with other reſiſtances, weights, or any other preſſures. In fact, we are meaſuring them all by the elaſticity of the ſpring. This elaſticity in its different poſitions is ſuppoſed to have the proportions of the weights which keep it in theſe poſitions. Thus we reaſon from the nature of gravity, no longer conſidered as a dead preſſure, but as a retarding force; and we apply our concluſions to reſiſtances which exhibit the ſame preſſures, but which we cannot make to act uniformly. This ſenſe of the words muſt be carefully remembered whenever we ſpeak of reſiſtances in pounds and ounces.

34 Gravity and reſiſtance compared when they are equal.

The moſt direct and convenient way of ſtating the compariſon between the reſiſtance of the air and the accelerating force of gravity, is to take a caſe in which we know that they are equal. Since the reſiſtance is here aſſumed as proportional to the ſquare of the velocity, it is evident that the velocity may be ſo increaſed that the reſiſtance ſhall equal or exceed the weight of the body. If a body be already moving downwards with this velocity, it cannot accelerate; becauſe the accelerating force of gravity is balanced by an equal retarding force of reſiſtance. It follows from this remark, that this velocity is the greateſt that a body can acquire by the force of gravity only. Nay, we ſhall afterwards ſee that it never can completely attain it; becauſe as it approaches to this velocity, the remaining accelerating force decreaſes faſter than the velocity increaſes. It may therefore be called the limiting or TERMINAL velocity by gravity.

Let a be the height through which a heavy body muſt fall, in vacuo, to acquire its terminal velocity in air. If projected directly upwards with this velocity, it will riſe again to this height, and the height is half the ſpace which it would deſcribe uniformly, with this velocity, in the time of its aſcent. Therefore the reſiſtance to this velocity being equal to the weight of the body, it would extinguiſh this velocity, by its *uniform* action, in the ſame time, and after the ſame diſtance, that gravity would.

Now let g be the velocity which gravity generates or extinguiſhes during an unit of time, and let u be the terminal velocity of any particular body. The theorems for perpendicular aſcents give us $g=\frac{u^2}{2a}$, u and a being both numbers repreſenting units of ſpace; therefore, in the preſent caſe, we have $r'=\frac{u^2}{2a}$. For the whole reſiſtance r, or r' M, is ſuppoſed equal to the weight, or to g M; and therefore r' is equal to $g, =\frac{u^2}{2a}$ and $2a=\frac{u^2}{g}$. There is a conſideration which ought to have place here. A body deſcends in air, not by the whole of its weight, but by the exceſs of its weight above that of the air which it diſplaces. It deſcends by its *ſpecific* gravity only as a ſtone does in water. Suppoſe a body 32 times heavier than air, it will be buoyed up by a force equal to $\frac{1}{32}$ of its weight; and inſtead of acquiring the velocity of 32 feet in a ſecond, it will only acquire a velocity of 31, even though it ſuſtained no reſiſtance from the *inertia* of the air. Let p be the weight of the body and π that of an equal bulk of air: the accelerative force of relative gravity on each particle will be $g\times 1-\frac{\pi}{p}$; and this relative accelerating force might be diſtinguiſhed by another ſymbol γ. But in all caſes in which we have any intereſt, and particularly in military projectiles, $\frac{\pi}{p}$ is ſo ſmall a quantity that it would be pedantic affectation to attend to it. It is much more than compenſated when we make $g=32$ feet inſtead of $32\frac{1}{12}$ which it ſhould be.

Let e be the time of this aſcent in oppoſition to gravity. The ſame theorems give us $eu=2a$; and ſince the reſiſtance competent to this terminal velocity is equal to gravity, e will alſo be the time in which it would be extinguiſhed by the uniform action of the reſiſtance; for which reaſon we may call it the extinguiſhing time for this velocity. Let R and E mark the reſiſtance and extinguiſhing time for the ſame body moving with the velocity 1.

Since the reſiſtances are as the ſquares of the velocities, and the reſiſtance to the velocity u is $\frac{u^2}{2a}$, R will be $=\frac{1}{2a}$. Moreover, the times in which the ſame velocity will be extinguiſhed by different forces, acting uniformly, are inverſely as the forces, and gravity would extinguiſh the velocity 1 in the time $\frac{1}{g}$, $=$ (in theſe meaſures) to $\frac{1}{\frac{u^2}{2a}}, =\frac{2a}{u^2}$. Therefore we have the following proportion $\frac{1}{2a}(=\text{R}):\frac{u^2}{2a}(=g)=\frac{2a}{u^2}:2a$, and $2a$ is equal to E, the time in which the velocity 1 will be extinguiſhed by the uniform action of the reſiſtance competent to this velocity.

The velocity 1 would in this caſe be extinguiſhed after a motion uniformly retarded, in which the ſpace deſcribed is one-half of what would be uniformly deſcribed during the ſame time with the conſtant velocity 1. Therefore the ſpace thus deſcribed by a motion which begins with the velocity 1, and is uniformly retarded by the reſiſtance competent to this velocity, is equal to the height through which *this* body muſt fall *in vacuo* in order to acquire *its* terminal velocity in air.

All theſe circumſtances may be conceived in a manner which, to ſome readers, will be more familiar and palpable. The terminal velocity is that where the reſiſtance of the air balances and is equal to the weight of the body. The reſiſtance of the air to any particular body is as the ſquare of the velocity; therefore let R be the whole reſiſtance to the body moving with the velocity

1, and r the reſiſtance to its motion with the terminal velocity u; we muſt have $r=R\times u^2$, and this muſt be $=W$ the weight. Therefore, to obtain the terminal velocity, divide the weight by the reſiſtance to the velocity 1, and the quotient is the ſquare of the terminal velocity, or $\frac{W}{R}=u^2$: And this is a very expeditious method of determining it, if R be previouſly known.

Then the common theorems give a, the fall neceſſary for producing this velocity *in vacuo* $=\frac{u^2}{2g}$, and the time of the fall $=\frac{u}{g}=e$, and $eu,=2a,=$ the ſpace uniformly deſcribed with the velocity u during the time of the fall, or its equal, the time of the extinction by the uniform action of the reſiſtance r; and, ſince r extinguiſhes it in the time e, R, which is u^2 times ſmaller, will extinguiſh it in the time u^2e, and R will extinguiſh the velocity 1, which is u times leſs than u, in the time $u\,e$, that is, in the time $2a$; and the body, moving uniformly during the time $2a$, $=E$, with the velocity 1, will deſcribe the ſpace $2a$; and, if the body begin to move with the velocity 1, and be uniformly oppoſed by the reſiſtance R, it will be brought to reſt when it has deſcribed the ſpace a; and the ſpace in which the reſiſtance to the velocity 1 will extinguiſh that velocity by its uniform action, is equal to the height through which that body muſt fall *in vacuo* in order to acquire its terminal velocity in air. And thus every thing is regulated by the time E in which the velocity 1 is extinguiſhed by the uniform action of the correſponding reſiſtance, or by $2\,a$, which is the ſpace uniformly deſcribed during this time, with the velocity 1. And E and $2a$ muſt be expreſſed by the ſame number. It is a number of units, of time, or of length.

35 The compariſon made general.

Having aſcertained theſe leading circumſtances for an unit of velocity, weight, and bulk, we proceed to deduce the ſimilar circumſtances for any other magnitude; and, to avoid unneceſſary complications, we ſhall always ſuppoſe the bodies to be ſpheres, differing only in diameter and denſity.

Firſt, then, let the velocity be increaſed in the ratio of 1 to v.

The reſiſtance will now be $\frac{v^2}{2a},=r$.

The extinguiſhing time will be $\frac{E}{v},=e,=\frac{2a}{v}$, and $e\,v=2a$; ſo that the rule is general, that the ſpace along which *any* velocity will be extinguiſhed by the uniform action of the correſponding reſiſtance, is equal to the height neceſſary for communicating the terminal velocity to *that* body by gravity. For $e\,v$ is twice the ſpace through which the body moves while the velocity v is extinguiſhed by the uniform reſiſtance.

In the 2d place, let the diameter increaſe in the proportion of 1 to d. The aggregate of the reſiſtance changes in the proportion of the ſurface ſimilarly reſiſted, that is, in the proportion of 1 to d^2. But the quantity of matter, or number of particles among which this reſiſtance is to be diſtributed, changes in the proportion of 1 to d^3. Therefore the retarding power of the reſiſtance changes in the proportion of 1 to $\frac{1}{d}$. When the diameter was 1, the reſiſtance to a velocity 1 was $\frac{1}{2a}$. It muſt now be $\frac{1}{2\,a\,d}$. The time in which this diminiſhed reſiſtance will extinguiſh the velocity 1 muſt increaſe in the proportion of the diminution of force, and muſt now be $E\,d$, or $2\,a\,d$, and the ſpace uniformly deſcribed during this time with the initial velocity 1 muſt be $2\,a\,d$; and this muſt ſtill be twice the height neceſſary for communicating the terminal velocity w to *this* body. We muſt ſtill have $g=\frac{w^2}{2\,a\,d}$; and therefore $w^2=2\,g\,a\,d$, and $w=\sqrt{2\,g\,a\,d},=\sqrt{2\,g\,a}\sqrt{d}$. But $u=\sqrt{2\,g\,a}$. Therefore the terminal velocity w for this body is $=u'\sqrt{d}$; and the height neceſſary for communicating it is $a\,d$. Therefore the terminal velocity varies in the ſubduplicate ratio of the diameter of the ball, and the fall neceſſary for producing it varies in the ſimple ratio of the diameter. The extinguiſhing time for the velocity v muſt now be $\frac{Ed}{v}$.

If, in the 3d place, the denſity of the ball be increaſed in the proportion of 1 to m, the number of particles among which the reſiſtance is to be diſtributed is increaſed in the ſame proportion, and therefore the retarding force of the reſiſtance is equally diminiſhed; and if the denſity of the air is increaſed in the proportion of 1 to n, the retarding force of the reſiſtance increaſes in the ſame proportion: hence we eaſily deduce theſe *general* expreſſions.

The terminal velocity $=u\sqrt{d\frac{m}{n}}.\ —=\sqrt{2\,g\,a\,d\frac{m}{n}}$.

The producing fall *in vacuo* $=ad\frac{m}{n}$

The retarding power of reſiſtance to any velocity $=r',=\frac{v^2}{2\,a\,d\frac{m}{n}}$.

The extinguiſhing time for any velocity $v=\frac{Edm}{vn}$.

And thus we ſee that the chief circumſtances are regulated by the terminal velocity, or are conveniently referred to it.

36 Units neceſſary by which the quantities may be meaſured.

To render the deductions from theſe premiſes perſpicuous, and for communicating diſtinct notions or ideas, it will be proper to aſſume ſome convenient units, by which all theſe quantities may be meaſured; and, as this ſubject is chiefly intereſting in the caſe of military projectiles, we ſhall adapt our units to this purpoſe. Therefore, let a ſecond be the unit of time, a foot the unit of ſpace and velocity, an inch the unit of diameter of a ball or ſhell, and a pound avoirdupoiſe the unit of preſſure, whether of weight or of reſiſtance; therefore g is 32 feet.

The great difficulty is to procure an abſolute meaſure of r, or u, or a; any one of theſe will determine the others

37 Sir Iſaac Newton's endeavours in this way.

Sir Iſaac Newton has attempted to determine r by theory, and employs a great part of the ſecond book of the *Principia* in demonſtrating, that the reſiſtance to a ſphere moving with any velocity is to the force which would generate or deſtroy its whole motion in the time that it would uniformly move over $\frac{8}{3}$ of its diameter with this velocity as the denſity of the air is to the denſity of the ſphere. This is equivalent to demonſtrating that the reſiſtance of the air to a ſphere moving through it with any velocity, is equal to half the weight of a column of air having a great circle of the ſphere for its baſe, and for its altitude the height from which a body muſt fall *in vacuo* to acquire this velocity. This appears from Newton's demonſtration; for, let the ſpecific gravity of the air be to that of the ball as 1 to m; then, becauſe the times in which the ſame velocity will be extinguiſhed by the uniform action of different forces are inverſely as the forces, the reſiſtance to this velocity would extinguiſh it in the time of deſcribing $\frac{8}{3}\, m\, d$, d being the diameter of the ball. Now 1 is to m as the weight of the diſplaced air to the weight of the ball, or as $\frac{2}{3}$ of the diameter of the ball to the length of a column of air of equal weight. Call this length a; a is therefore equal to $\frac{2}{3}\, m\, d$. Suppoſe the ball to fall from the height a in the time t, and acquire the velocity u. If it moved uniformly with this velocity during this time, it would deſcribe a ſpace $= 2\, a$, or $\frac{4}{3}\, m\, d$. Now its weight would extinguiſh this velocity, or deſtroy this motion, in the ſame time, that is, in the time of deſcribing $\frac{4}{3}\, m\, d$; but the reſiſtance of the air would do this in the time of deſcribing $\frac{8}{3}\, m\, d$; that is, in twice the time. The reſiſtance therefore is equal to half the weight of the ball, or to half the weight of the column of air whoſe height is the height producing the velocity. But the reſiſtances to different velocities are as the ſquares of the velocities; and therefore, as their producing heights, and, in general, the reſiſtance of the air to a ſphere moving with any velocity, is equal to the half weight of a column of air of equal ſection, and whoſe altitude is the height producing the velocity.

38 His reſult juſt, but his reaſoning erroneous.

The reſult of this inveſtigation has been acquieſced in by all Sir Iſaac Newton's commentators. Many faults have indeed been found with his reaſoning, and even with his pirnciples; and it muſt be acknowledged that although this inveſtigation is by far the moſt ingenious of any in the *Principia*, and ſets his acuteneſs and addreſs in the moſt conſpicuous light, his reaſoning is liable to ſerious objections, which his moſt ingenious commentators have not completely removed. However, the concluſion has been acquieſced in, as we have already ſtated, but as if derived from other principles, or by more logical reaſoning. We cannot, however, ſay that the reaſonings or aſſumptions of theſe mathematicians are much better than Newton's: and we muſt add that all the cauſes of deviation from the duplicate ratio of the velocities, and the cauſes of increaſed reſiſtance, which the later authors have valued themſelves for diſcovering and introducing into their inveſtigations, were pointed out by Sir Iſaac Newton, but purpoſely omitted by him, in order to facilitate the diſcuſſion *in re difficillima*. (See *Schol.* prop. 37. b. ii.)

It is known that the weight of a cubic foot of water is $62\frac{1}{2}$ pounds, and that the medium denſity of the air is $\frac{1}{840}$ of water; therefore let a be the height producing the velocity (in feet), and d the diameter of the ball (in inches), and π the periphery of a circle whoſe diameter is 1; the reſiſtance of the air will be

$$= \frac{62\frac{1}{2}}{840} \times \frac{\pi}{4} \times \frac{1}{144} \times \frac{a}{2} \times d^2 = \frac{a\,d^2}{4928\frac{1}{2}} \text{ pounds, very nearly, } = \frac{v^2}{4928\frac{1}{2} \times 64}\, d^2, = \frac{v^2\, d^2}{315417} \text{ pounds.}$$

We may take an example. A ball of caſt iron weighing 12 pounds, is $4\frac{1}{2}$ inches in diameter. Suppoſe this ball to move at the rate of $25\frac{1}{10}$ feet in a ſecond (the reaſon of this choice will appear afterwards). The height which will produce this velocity in a falling body is $9\frac{7}{8}$ feet. The area of its great circle is 0,11044 feet, or $\frac{11044}{1000000}$ of one foot. Suppoſe water to be 840 times heavier than air, the weight of the air incumbent on this great circle, and $9\frac{7}{8}$ feet high, is 0,081151 pounds: half of this is 0,0405755 or $\frac{405755}{10000000}$ or nearly $\frac{1}{25}$ of a pound. This ſhould be the reſiſtance of the air to this motion of the ball.

39 Neceſſity of experiment.

In all matters of phyſical diſcuſſion, it is prudent to confront every theoretical concluſion with experiment. This is particularly neceſſary in the preſent inſtance, becauſe the theory on which this propoſition is founded is extremely uncertain. Newton ſpeaks of it with the moſt cautious diffidence, and ſecures the juſtneſs of the concluſions by the conditions which he aſſumes in his inveſtigation. He deſcribes with the greateſt preciſion the ſtate of the fluid in which the body muſt move, ſo as that the demonſtration may be ſtrict, and leaves it to others to pronounce whether this is the real conſtitution of our atmoſphere. It muſt be granted that it is not; and that many other ſuppoſitions have been introduced by his commentators and followers, in order to ſuit his inveſtigation (for we muſt aſſert that little or nothing has been added to it) to the circumſtances of the caſe.

40 Newton's experiments.

Newton himſelf, therefore attempted to compare his propoſitions with experiment. Some were made by dropping balls from the dome of St Paul's cathedral; and all theſe ſhowed as great a coincidence with his theory as they did with each other: but the irregularities were too great to allow him to ſay with preciſion what was the reſiſtance. It appeared to follow the proportion of the ſquares of the velocities with ſufficient exactneſs; and though he could not ſay that the reſiſtance was equal to the weight of the column of air having the height neceſſary for communicating the velocity, it was always equal to a determinate part of it; and might be ſtated $= n\, a$, n being a number to be fixed by numerous experiments.

One great ſource of uncertainty in his experiments ſeems to have eſcaped his obſervation: the air in that dome is almoſt always in a ſtate of motion. In the ſummer ſeaſon there is a very ſenſible current of air downwards, and frequently in winter it is upwards: and this current bears a very great proportion to the velocity of the deſcents. Sir Iſaac takes no notice of this.

He made another ſet of experiments with pendulums; and has pointed out ſome very curious and unexpected circumſtances of their motions in a reſiſting medium. There is hardly any part of his noble work in which his addreſs, his patience, and his aſtoniſhing penetration, appear in greater luſtre. It requires the utmoſt intenſeneſs of thought to follow him in theſe diſquiſitions; and we cannot enter on the ſubject at preſent: ſome notice will be taken of theſe experiments in the article RESISTANCE *of Fluids*. Their reſults were much more uniform, and confirmed his general theory; and, as we have ſaid above, it has been acquieſced in by the firſt mathematicians of Europe.

41 Inutility of the theory in practice.

But the deductions from this theory were ſo inconſiſtent with the obſerved motions of military projectiles, when the velocities are prodigious, that no application could be made which could be of any ſervice for determining

42
The attempts of various mathematicians, &c.

mining the path and motion of cannon ſhot and bombs; and although Mr John Bernoulli gave in 1718 a moſt elegant determination of the trajectory and motion of a body projected in a fluid which reſiſts in the duplicate ratio of the velocities (a problem which even Newton did not attempt), it has remained a dead letter. Mr Benjamin Robins, equally eminent for phyſical ſcience and mathematical genius, was the firſt who ſuſpected the true cauſe of the imperfection of the uſually received theories; and in 1737 he publiſhed a ſmall tract, in which he ſhowed clearly, that even the Newtonian theory of reſiſtance muſt cauſe a cannon ball, diſcharged with a full allotment of powder, to deviate farther from the parabola, in which it would move *in vacuo*, than the parabola deviates from a ſtraight line. But he farther aſſerted, on the authority of good reaſoning, that in ſuch great velocities the reſiſtance muſt be much greater than this theory aſſigns; becauſe, beſides the reſiſtance ariſing from the *inertia* of the air which is put in motion by the ball, there muſt be a reſiſtance ariſing from a condenſation of the air on the anterior ſurface of the ball, and a rarefaction behind it: and there muſt be a third reſiſtance, ariſing from the ſtatical preſſure of the air on its anterior part, when the motion is ſo ſwift that there is a vacuum behind. Even theſe cauſes of diſagreement with the theory had been foreſeen and mentioned by Newton (ſee the Scholium to prop. 37, Book II. *Princip.*); but the ſubject ſeems to have been little attended to. The eminent mathematicians had few opportunities of making experiments; and the profeſſional men, who were in the ſervice of princes, and had their countenance and aid in this matter, were generally too deficient in mathematical knowledge to make a proper uſe of their opportunities. The numerous and ſplendid volumes which theſe gentlemen have been enabled to publiſh by the patronage of ſovereigns are little more than prolix extenſions of the ſimple theory of Galileo. Some of them, however, ſuch as St Remy, Antonini, and Le Blond, have given moſt valuable collections of experiments, ready for the uſe of the profound mathematician.

43
Obſervations of Mr Robins on velocity and reſiſtance,

Two or three years after this firſt publication, Mr Robins hit upon that ingenious method of meaſuring the great velocities of military projectiles, which has handed down his name to poſterity with great honour. And having aſcertained theſe velocities, he diſcovered the prodigious reſiſtance of the air, by obſerving the diminution of velocity which it occaſioned. This made him anxious to examine what was the real reſiſtance to any velocity whatever, in order to aſcertain what was the law of its variation; and he was equally fortunate in this attempt. His method of meaſuring the reſiſtance has been fully deſcribed in the article Gunnery, n° 9, &c.

It appears (Robins's *Math. Works*, vol. i. page 205.) that a ſphere of 4½ inches in diameter, moving at the rate of 25⅕ feet in a ſecond, ſuſtained a reſiſtance of 0,04914 pounds, or $\frac{4914}{100000}$ of a pound. This is a greater reſiſtance than that of the Newtonian theory, which gave $\frac{405755}{10000000}$ in the proportion of 1000 to 1211, or very nearly in the proportion of five to ſix in ſmall numbers. And we may adopt as a rule in all moderate velocities, that the reſiſtance to a ſphere is equal to $\frac{61}{100}$ of the weight of a column of air having the great circle of the ſphere for its baſe, and for its altitude the height through which a heavy body muſt fall *in vacuo* to acquire the velocity of projection.

This experiment is peculiarly valuable, becauſe, the ball is preciſely the ſize of a 12 pound ſhot of caſt iron, and its accuracy may be depended on. There is but one ſource of error. The whirling motion muſt have occaſioned ſome whirl in the air, which would continue till the ball again paſſed through the ſame point of its revolution. The reſiſtance obſerved is therefore probably ſomewhat leſs than the true reſiſtance to the velocity of 25⅕ feet, becauſe it was exerted in a relative velocity which was leſs than this, and is, in fact, the reſiſtance competent to this relative and ſmaller velocity.

44
And of Mr Rouſe and De Borda.

—Accordingly, Mr Smeaton, a moſt ſagacious naturaliſt, places great confidence in the obſervations of a Mr Rouſe of Leiceſterſhire, who meaſured the reſiſtance by the effect of the wind on a plane properly expoſed to it. He does not tell us in what way the velocity of the wind was aſcertained; but our deference for his great penetration and experience diſpoſes us to believe that the point was well determined. The reſiſtance obſerved by Mr Rouſe exceeds that reſulting from Mr Robins's experiments nearly in the proportion of 7 to 10.

45
They differ widely in their concluſions.

Chevalier de Borda made experiments ſimilar to thoſe of Mr Robins, and his reſults exceed thoſe of Robins in the proportion of 5 to 6. Theſe differences are ſo conſiderable, that we are at a loſs what meaſure to abide by. It is much to be regretted, that in a ſubject ſo intereſting both to the philoſopher and the man of the world, experiments have not been multiplied. Nothing would tend ſo much to perfect the ſcience of gunnery; and indeed till this be done, all the labours of mathematicians are of no avail. Their inveſtigations muſt remain an unintelligible cipher, till this key be ſupplied. It is to be hoped that Dr Charles Hutton of Woolwich, who has ſo ably extended Mr Robins's Examination of the Initial Velocities of Military Projectiles, will be encouraged to proceed to this part of the ſubject. We ſhould wiſh to ſee, in the firſt place, a numerous ſet of experiments for aſcertaining the reſiſtance in moderate velocities: and, in order to avoid all error from the reſiſtance and inertia of the machine, which is neceſſarily blended with the reſiſtance of the ball, in Mr Robins's form of the experiment, and is ſeparated with great uncertainty and riſk of error, we would recommend a form of experiment ſomewhat different.

46
A new form of experiment recommended.

Let the axis and arm which carries the ball be connected with wheelwork, by which it can be put in motion, and gradually accelerated. Let the ball be ſo connected with a bent ſpring, that this ſhall gradually compreſs it as the reſiſtance increaſes, and leave a mark of the degree of compreſſion; and let all this part of the apparatus be ſcreened from the air except the ball. The velocity will be determined preciſely by the revolutions of the arm, and the reſiſtance by the compreſſion of the ſpring. The beſt method would be to let this part of the apparatus be made to ſlide along the revolving arm, ſo that the ball can be made to deſcribe larger and larger circles. An intelligent mechanician will eaſily contrive an apparatus of this kind, held at any diſtance from the axis by a cord, which paſſes over a pulley in the axis itſelf, and is then brought along a perforation in the axis, and comes out at its extremity, where it is fitted with a ſwivel, to prevent it from ſnapping by being twiſted. Now let the machine be put in motion. The centrifugal force of the ball and apparatus will cauſe it to fly out as far as it is allowed by the cord;

and if the whole is put in motion by connecting it with ſome mill, the velocity may be moſt accurately aſcertained. It may alſo be fitted with a bell and hammer like Graveſande's machine for meaſuring centrifugal forces. Now by gradually veering off more cord, the diſtance from the centre, and conſequently the velocity and reſiſtance increaſe, till the hammer is diſengaged and ſtrikes the bell.

Another great advantage of this form of the experiment is, that the reſiſtance to very great velocities may be thus examined, which was impoſſible in Mr Robins's way. This is the great deſideratum, that we may learn in what proportion of the velocities the reſiſtances increaſe.

In the ſame manner, an apparatus, conſiſting of Dr Lynd's Anemometer, deſcribed in the article PNEUMATICS, n° 311, &c. might be whirled round with prodigious rapidity, and the fluid on it might be made clammy, which would leave a mark at its greateſt elevation, and thus diſcover the reſiſtance of the air to rapid motions.

Nay, we are of opinion that the reſiſtance to very rapid motions may be meaſured directly in the conduit pipe of ſome of the great cylinder bellows employed in blaſt furnaces; the velocity of the air in this pipe is aſcertained by the capacity of the cylinder and the ſtrokes of the piſton. We think it our duty to point out to ſuch as have the opportunities of trying them methods which promiſe accurate reſults for aſcertaining this moſt deſirable point.

47
The reſult of Robins's experiments as yet moſt to be depended on.

We are the more puzzled what meaſure to abide by, becauſe Mr Robins himſelf, in his Practical Propoſitions, does not make uſe of the reſult of his own experiments, but takes a much lower meaſure. We muſt content ourſelves, however, with this experimental meaſure, becauſe it is as yet the only one of which any account can be given, or well-founded opinion formed.

48
Applied to the formulæ.

Therefore, in order to apply our formulæ, we muſt reduce this experiment which was made on a ball of $4\frac{1}{2}$ inches diameter, moving with the velocity of $25\frac{1}{5}$ feet per ſecond, to what would be the reſiſtance to a ball of one inch, having the velocity 1 foot. This will evidently give us $R = \frac{0,04914}{4,5^2 \times 25.2^2}$, being diminiſhed in the duplicate ratio of the diameter and velocity. This gives us $R = 0,00000381973$ pounds, or $\frac{3.81973}{1000000}$ of a pound. The logarithm is $\bar{4},58204$. The reſiſtance here determined is the ſame whatever ſubſtance the ball be of; but the retardation occaſioned by it will depend on the proportion of the reſiſtance to the *vis inſita* of the ball; that is, to its quantity of motion. This in ſimilar velocities and diameters is as the denſity of the ball. The balls uſed in military ſervice are of caſt iron or of lead, whoſe ſpecific gravities are 7,207 and 11,37 nearly, water being 1. There is conſiderable variety in caſt iron, and this denſity is about the medium. Theſe data will give us.

		For Iron.	For Lead.
W, or weight of a ball 1 inch in diameter	- -	lbs. 0,13648	0,21533
Log. of W	- -	9.13509	9.33310
E″	- - -	1116″,6	1761″,6
Log. of E	- -	3.04790	3.24591
u, or terminal velocity	-	189,03	237,43
Log. u	- -	2.27653	2.37553
a, or producing height	-	558,3	880,8

Theſe numbers are of frequent uſe in all queſtions on this ſubject.

Mr Robins gives an expeditious rule for readily finding a, which he calls F (ſee the article GUNNERY), by which it is made 900 feet for a caſt iron ball of an inch diameter. But no theory of reſiſtance which he profeſſes to uſe will make this height neceſſary for producing the terminal velocity. His F therefore is an *empirical* quantity, anologous indeed to the producing height, but accommodated to his theory of the trajectory of cannon ſhot, which he promiſed to publiſh, but did not live to execute. We need not be very anxious about this; for all our quantities change in the ſame proportion with R, and need only a correction by a multiplier or diviſor, when R ſhall be accurately eſtabliſhed.

We may illuſtrate the uſe of theſe formula by an example or two.

49
Examples of their uſe.

1. Then, to find the reſiſtance to a 24 pound ball moving with the velocity of 1670 feet in a ſecond, which is nearly the velocity communicated by 16 lbs. of powder. The diameter is 5,603 inches.

Log. R	- -	$+\bar{4}.58204$
Log. d^2	- -	$+1.49674$
Log. 1670^2	- -	$+6.44548$
Log. 334,4 lbs. $= r$	-	2.52426

But it is found, by unequivocal experiments on the retardation of ſuch a motion, that it is 504 lbs. This is owing to the cauſes often mentioned, the additional reſiſtance to great velocities, ariſing from the condenſation of the air, and from its preſſure into the vacuum left by the ball.

2. Required the terminal velocity of this ball?

Log. R	- -	$+4.58204$
Log. d^2	- - -	$+1.49674$
Log. reſiſt. to veloc. 1	-	$6.07878 = a$
Log. W	- -	$1.38021 = b$
Diff. of a and b, $=$ log u^2	-	5.30143
Log. 447,4 $= u$	-	2.65071

50
Table of terminal velocity according to Newton and Robins.

As the terminal velocity u, and its producing height a, enter into all computations of military projectiles, we have inſerted the following Table for the uſual ſizes of cannon-ſhot, computed both by the Newtonian theory of reſiſtance, and by the reſiſtances obſerved in Robins's experiments.

Lb. Ball.	Newton.		Robins.		Diam. Inch.
	u. Term. Vel.	2 a.	Term. Vel.	2 a.	
1	289,9	2626,4	263,4	2168,6	1,94
2	324,9	3298,5	295,2	2723,5	2,45
3	348,2	3788,2	316,4	3127,9	2,80
4	365,3	4170,3	331,9	3442,6	3,08
6	390,8	4472,7	355,1	3940,7	3,52
9	418,1	5463,5	379,9	4511,2	4,04
12	438,6	6010,6	398,5	4962,9	4,45
18	469,3	6883,3	426,5	5683,5	5,09
24	492,4	7576,3	447,4	6255,7	5,61
32	512,6	8024,8	465,8	6780,4	6,21
	540,5	9129,9	491,5	7538,3	6,75

Mr Muller, in his writings on this ſubject, gives a much

51 Mr Muller's theory altogether erroneous.

much ſmaller meaſure of reſiſtance, and conſequently a much greater terminal velocity: but his theory is a miſtake from beginning to end (See his *Supplement* to his *Treatiſe of Artillery*, art. 150, &c.) In art. 148. he aſſumes an algebraic expreſſion for a principle of mechanical argument; and from its conſequence draws erroneous concluſions. He makes the reſiſtance of a cylinder $\frac{1}{3}$ leſs than Newton *ſuppoſes* it; and his reaſon is falſe. Newton's meaſure is demonſtrated by his commentators Le Seur and Jaquier to be even a little too ſmall, upon his own principles, (Not. 277. Prop. 36. B. II.) Mr Muller then, without any ſeeming reaſon, introduces a new principle, which he makes the chief ſupport of his theory, in oppoſition to the theories of other mathematicians. The principle is falſe, and even abſurd, as we ſhall have occaſion to ſhow by and by. In conſequence, however, of this principle, he is enabled to compare the reſults with many experiments, and the agreement is very flattering. But we ſhall ſoon ſee that little dependence can be had on ſuch compariſons. We notice theſe things here, becauſe Mr Muller being head of the artillery ſchool in Britain, his publications have become a ſort of text-books. We are miſerably deficient in works on this ſubject, and muſt have recourſe to the foreign writers.

52 The motions conſidered through their whole courſe.

We now proceed to conſider theſe motions through their whole courſe: and we ſhall firſt conſider them as affected by the reſiſtance only; then we ſhall conſider the perpendicular aſcents and deſcents of heavy bodies through the air; and, laſtly, their motion in a curvilineal trajectory, when projected obliquely. This muſt be done by the help of the abſtruſer parts of fluxionary mathematics. To make it more perſpicuous, we ſhall, by way of introduction, conſider the ſimply reſiſted rectilineal motions geometrically, in the manner of Sir Iſaac Newton. As we advance, we ſhall quit this track, and proſecute it algebraically, having by this time acquired diſtinct ideas of the algebraic quantities.

33 Preliminary obſervations.

We muſt keep in mind the fundamental theorems of varied motions.

1. The momentary variation of the velocity is proportional to the force and the moment of time jointly, and may therefore be repreſented by $\pm\dot{v}=f\dot{t}$, where $\dot{v}$ is the momentary increment or decrement of the velocity v, f the accelerating or retarding force, and $\dot{t}$ the moment or increment of the time t.

2. The momentary variation of the ſquare of the velocity is as the force, and as the increment or decrement of the ſpace jointly; and may be repreſented by $\pm v\dot{v}=f\dot{s}$. The firſt propoſition is familiarly known. The ſecond is the 39th of Newton's *Principia*, B. I. It is demonſtrated in the article OPTICS, p. 281. and is the moſt extenſively uſeful propoſition in mechanics.

53 The motions as affected by reſiſtance only. Plate CCCCXVII.

Theſe things being premiſed, let the ſtraight line AC (fig. 6.) repreſent the initial velocity V, and let CO, perpendicular to AC, be the time in which this velocity would be extinguiſhed by the uniform action of the reſiſtance, Draw through the point A an equilateral hyperbola A*e*B, having OF, OCD for its aſſymptotes; then let the time of the reſiſted motion be repreſented by the line CB, C being the firſt inſtant of the motion. If there be drawn perpendicular ordinates *κe*, *gf*, DB &c. to the hyperbola, they will be proportional to the velocities of the body at the inſtants *κ*, *g*, D, &c. and the hyperbolic areas AC*κe* AC*gf*, ACDB, &c. will be proportional to the ſpaces deſcribed during the times C*κ*, C*g*, CB, &c.

For, ſuppoſe the time divided into an indefinite number of ſmall and equal moments, C*c*, D*d*, &c. draw the ordinates *ac*, *bd*, and the perpendiculars *bβ*, *aα*. Then, by the nature of the hyperbola, AC : *ac*=O*c* : OC; and AC—*ac* : *ac*=O*c*—OC : OC, that is, A*α* : *ac*=C*c* : OC, and A*α* : C*c*=*ac* : OC, =AC·*ac* : AC·OC; in like manner, B*β* : D*d*=BD·*b*D : BD·OD. Now D*d*=C*c*, becauſe the moments of time were taken equal, and the rectangles AC·CO, BD·DO, are equal, by the nature of the hyperbola; therefore A*α* : B*β*=AC·*ac* : BD·*bd*: but as the points *c*, *d* continually approach, and ultimately coincide with C, D, the ultimate ratio of AC·*ac* to BD·*bd* is that of AC^2 to BD^2; therefore the momentary decrements of AC and BD are as AC^2 and BD^2. Now, becauſe the reſiſtance is meaſured be the momentary diminution of velocity, theſe diminutions are as the ſquares of the velocities; therefore the ordinates of the hyperbola and the velocities diminiſh by the ſame law; and the initial velocity was repreſented by AC: therefore the velocities at all the other inſtants *κ*, *g*, D are properly repreſented by the correſponding ordinates. Hence,

1. Since the abſciſſæ of the hyperbola are as the times, and the ordinates are as the velocities, the areas will be as the ſpaces deſcribed, and AC*κe* is to A*cgf* as the ſpace deſcribed in the time C*κ* to the ſpace deſcribed in the time C*g* (1ſt Theorem on varied motions).

2. The rectangle ACOF is to the area ACDB as the ſpace formerly expreſſed by 2*a*, or E to the ſpace deſcribed in the reſiſting medium during the time CD: for AC being the velocity V, and OC the extinguiſhing time *e*, this rectangle is=*e*V, or E, or 2*a*, of our former diſquiſitions; and becauſe all the rectangles, ſuch as ACOF, BDOG, &c, are equal, this correſponds with our former obſervation, that the ſpace uniformly deſcribed with any velocity during the time in which it would be uniformly extinguiſhed by the correſponding reſiſtance is a conſtant quantity, viz. that in which we always had $ev=E$, or 2*a*.

3. Draw the tangent A*κ*, then, by the hyperbola C*κ*=CO: now C*κ* is the time in which the reſiſtance to the velocity AC would extinguiſh it; for the tangent coinciding with the elemental arc A*a* of the curve, the firſt impulſe of the uniform action of the reſiſtance is the ſame with the firſt impulſe of its varied action. By this the velocity AC is reduced to *ac*. If this operated uniformly like gravity, the velocities would diminiſh uniformly, and the ſpace deſcribed would be repreſented by the triangle AC*κ*.

This triangle, therefore, repreſents the height thro' which a heavy body muſt fall in vacuo, in order to acquire the terminal velocity.

4. The motion of a body reſiſted in the duplicate ratio of the velocity will continue without end, and a ſpace will be deſcribed which is greater than any aſſignable ſpace, and the velocity will grow leſs than any that can be aſſigned; for the hyperbola approaches continually to the aſſymptote, but never coincides with it. There is no velocity BD ſo ſmall, but a ſmaller ZP will be found beyond it; and the hyperbolic ſpace

may be continued till it exceeds any ſurface that can be aſſigned.

5. The initial velocity AC is to the final velocity BD as the ſum of the extinguiſhing time and the time of the retarded motion, is to the extinguiſhing time alone : for $\mathrm{AC} : \mathrm{BD} = \mathrm{OD}$ $(\text{or } \mathrm{OC}+\mathrm{CD}) : \mathrm{OC}$; or $\mathrm{V} : v = e : e + t$.

6. The extinguiſhing time is to the time of the retarded motion as the final velocity is to the velocity loſt during the retarded motion : for the rectangles AFOC, BDOG are equal ; and therefore AVGF and BVCD are equal and $\mathrm{VC} : \mathrm{VA} = \mathrm{VG} : \mathrm{VB}$; therefore $t = e\frac{\mathrm{V}-v}{v}$, and $e = t\frac{v}{\mathrm{V}-v}$.

7. Any velocity is reduced in the proportion of m to n in the time $e\frac{m-n}{n}$. For, let $\mathrm{AC} : \mathrm{BD} = m : n$; then $\mathrm{DO} : \mathrm{CO} = m : n$, and $\mathrm{DC} : \mathrm{CO} = m - n : n$, and $\mathrm{DC} = \frac{m-n}{n}\mathrm{CO}$, or $t = e\frac{m-n}{n}$. Therefore any velocity is reduced to one half in the time in which the initial reſiſtance would have extinguiſhed it by its uniform action.

55 Another mode of determining this motion.

Thus may the chief circumſtances of this motion be determined by means of the hyperbola, the ordinates and abſciſſæ exhibiting the relations of the times and velocities, and the areas exhibiting the relations of both to the ſpaces deſcribed. But we may render the conception of theſe circumſtances infinitely more eaſy and ſimple, by expreſſing them all by lines, inſtead of this combination of lines and ſurfaces. We ſhall accompliſh this purpoſe by conſtructing another curve LKP, having the line MLδ, parallel to OD for its abſciſſa, and of ſuch a nature, that if the ordinates to the hyperbola AC, $e\varkappa$, fg, BD, &c. be produced till they cut this curve in L, p, n, K, &c. and the abſciſſa in L, ι, h, δ, &c. the ordinates ιp, hn, δK, &c. may be proportional to the hyperbolic areas $e\mathrm{A}c\varkappa$, $f\,a\,c\,\mathrm{O}$, $\delta\mathrm{A}c\mathrm{K}$. Let us examine what kind of curve this will be.

Make $\mathrm{OC} : \mathrm{O}\varkappa = \mathrm{O}\varkappa : \mathrm{O}g$; then (Hamilton's *Conics*, IV. 14. Cor.), the areas AC$\varkappa q$, $e\varkappa gf$ are equal : therefore drawing ps, nt perpendicular to OM, we ſhall have (by the aſſumed nature of the curve LpK), $\mathrm{M}s = st$; and if the abſciſſa OD be divided into any number of ſmall parts in geometrical progreſſion (reckoning the commencement of them all from O), the axis Vi of this curve will be divided by its ordinates into the ſame number of equal parts ; and this curve will have its ordinates LM, ps, nt, &c. in geometrical progreſſion, and its abſciſſæ in arithmetical progreſſion.

Alſo, let KN, MV touch the curve in K and L, and let OC be ſuppoſed to be to Oc, as OD to Od, and therefore Cc to Dd as OC to OD ; and let theſe lines Cc, Dd be indefinitely ſmall ; then (by the nature of the curve) Lo is equal to Kr: for the areas $a$AC$c$, $b$BD$d$ are in this caſe equal. Alſo lo is to kr, as LM to KI, becauſe $c\mathrm{C} : d\mathrm{D} = \mathrm{CO} : \mathrm{DO}$:

Therefore $\mathrm{IN} : \mathrm{IK} = r\mathrm{K} : rk$
$\mathrm{IK} : \mathrm{ML} = rk : ol$
$\mathrm{ML} : \mathrm{MV} = ol : o\mathrm{I}$.
and $\mathrm{IN} : \mathrm{MN} = r\mathrm{K} : o\mathrm{L}$.

That is, the ſubtangent IN, or MV, is of the ſame magnitude, or is a conſtant quantity in every part of the curve.

Laſtly, the ſubtangent IN, correſponding to the point K of the curve, is to the ordinate Kδ as the rectangle BDOG or ACOF to the parabolic area BDCA.

For let $fghn$ be an ordinate very near to BDδK ; and let hn cut the curve in n, and the ordinate KI in q; then we have

$\mathrm{K}q : qn = \mathrm{KI} : \mathrm{IN}$, or
$\mathrm{D}g : qn = \mathrm{DO} : \mathrm{IN}$;
but $\mathrm{BD} : \mathrm{AC} = \mathrm{CO} : \mathrm{DO}$;
therefore $\mathrm{BD} . \mathrm{D}g : \mathrm{AC} . qn = \mathrm{CO} : \mathrm{IN}$:

Therefore the ſum of all the rectangles BD.Dg is to the ſum of all the rectangles AC . qn, as CO to IN ; but the ſum of the rectangles BD . Dg is the ſpace ACBD ; and, becauſe AC is given, the ſum of the rectangles AC . qn is the rectangle of AC and the ſum of all the lines qn; that is, the rectangle of AC and RL : therefore the ſpace $\mathrm{ACDB} : \mathrm{AC} . \mathrm{RL} = \mathrm{CO} : \mathrm{IN}$, and $\mathrm{ACDB} \times \mathrm{IN} = \mathrm{AC} . \mathrm{CO} . \mathrm{RL}$; and therefore $\mathrm{IN} : \mathrm{RL} = \mathrm{AC} . \mathrm{CO} : \mathrm{ACDB}$.

Hence it follows that QL expreſſes the area BVA, and, in general, that the part of the line parallel to OM, which lies between the tangent KN and the curve LpK, expreſſes the correſponding area of the hyperbola which lies without the rectangle BDOG.

And now, by the help of this curve, we have an eaſy way of conceiving and computing the motion of a body through the air. For the ſubtangent of our curve now repreſents twice the height through which the ball muſt fall in vacuo, in order to acquire the terminal velocity ; and therefore ſerves for a ſcale on which to meaſure all the other repreſentatives of the motion.

56 The whole reduced to a ſimple arithmetical computation.

But it remains to make another obſervation on the curve LpK, which will ſave us all the trouble of graphical operations, and reduce the whole to a very ſimple arithmetical computation. It is of ſuch a nature, that when MI is conſidered as the abſciſſa, and is divided into a number of equal parts, and ordinates are drawn from the points of diviſion, the ordinates are a ſeries of lines in geometrical progreſſion, or are continual proportionals. Whatever is the ratio between the firſt and ſecond ordinate, there is the ſame between the ſecond and third, between the third and fourth, and ſo on ; therefore the number of parts into which the abſciſſa is divided is the number of theſe equal ratios which is contained in the ratio of the firſt ordinate to the laſt : For this reaſon, this curve has got the name of the *logiſtic* or *logarithmic* curve ; and it is of immenſe uſe in the modern mathematics, giving us the ſolution of many problems in the moſt ſimple and expeditious manner, on which the genius of the ancient mathematicians had been exerciſed in vain. Few of our readers are ignorant, that the numbers called *logarithms* are of equal utility in arithmetical operations, enabling us not only to ſolve common arithmetical problems with aſtoniſhing diſpatch, but alſo to ſolve others which are quite inacceſſible in any other way. Logarithms are nothing more than the numerical meaſures of the abſciſſa of this curve, correſponding to ordinates, which are meaſured on the ſame or any other ſcale by the natural numbers ; that is, if MLδ be divided into equal parts, and from the points of diviſion lines be drawn parallel to

MI, cutting the curve L*p*K, and from the points of interſection ordinates be drawn to MI, theſe will divide MI into portions, which are in the ſame proportion to the ordinates that the logarithms bear to their natural numbers.

In conſtructing this curve we were limited to no particular length of the line LR, which repreſented the ſpace ACDB; and all that we had to take care of was, that when OC, O *n*, O *g* were taken in geometrical progreſſion, M *s*, M *t* ſhould be in arithmetical progreſſion. The abſciſſæ having ordinates equal to *p s*, *n t*, &c. might have been twice as long, as is ſhown in the dotted curve which is drawn through L. All the lines which ſerve to meaſure the hyperbolic ſpaces would then have been doubled. But NI would alſo have been doubled, and our proportions would have ſtill held good; becauſe this ſubtangent is the ſcale of meaſurement of our figure, as E or 2 *a* is the ſcale of meaſurement for the motions.

Since then we have tables of logarithms calculated for every number, we may make uſe of them inſtead of this geometrical figure, which ſtill requires conſiderable trouble to ſuit it to every caſe. There are two ſets of logarithmic tables in common uſe. One is called a table of hyperbolic or natural logarithms. It is ſuited to ſuch a curve as is drawn in the figure, where the ſubtangent is equal to that ordinate $\tau\upsilon$ which correſponds to the ſide πO of the ſquare $\pi\theta\lambda$O inſerted between the hyperbola and its aſſymptotes. This ſquare is the unit of ſurface, by which the hyperbolic areas are expreſſed; its ſide is the unit of length, by which the lines belonging to the hyperbola are expreſſed; $\tau\upsilon$ is $= 1$, or the unit of numbers to which the logarithms are ſuited, and then IN is alſo 1. Now the ſquare $\theta\pi$Oλ being unity, the area BACD will be ſome number; π O being alſo unity, OD is ſome number: Call it x. Then, by the nature of the hyperbola, OB : O π = π θ : DB: That is, $x : 1 = 1 : \frac{1}{x}$, ſo that DB is $\frac{1}{x}$. Now calling D *d* $\dot{x}$, the area B D *d b*, which is the fluxion (ultimately) of the hyperbolic area, is $\frac{\dot{x}}{x}$. Now in the curve L*p*K, MI has the ſame ratio to NI that BACD has to $\theta\lambda$Oπ: Therefore, if there be a ſcale of which NI is the unit, the number on this ſcale correſponding to MI has the ſame ratio to 1 which the number meaſuring BACD has to 1; and I *i*, which correſponds to BD *db*, is the fluxion (ultimately) of MI: Therefore, if MI be called the logarithm of x, $\frac{\dot{x}}{x}$ is properly repreſented by the fluxion of MI. In ſhort, the line MI is divided preciſely as the line of numbers on a Gunter's ſcale, which is therefore a line of logarithms; and the numbers called logarithms are juſt the lengths of the different parts of this line meaſured on a ſcale of equal parts. Therefore, when we meet with ſuch an expreſſion as $\frac{\dot{x}}{x}$ viz. the fluxion of a quantity divided by the quantity itſelf, we conſider it as the fluxion of the logarithm of that quantity, becauſe it is really ſo when the quantity is a number; and it is therefore ſtrictly true that the fluent of $\frac{\dot{x}}{x}$ is the hyperbolic logarithm of x.

Certain reaſons of convenience have given riſe to another ſet of logarithms; theſe are ſuited to a logiſtic curve whoſe ſubtangent is only $\frac{43429}{100000}$ of the ordinate $\tau\upsilon$, which is equal to the ſide of the hyperbolic ſquare, and which is aſſumed for the unit of number. We ſhall ſuit our applications of the preceding inveſtigation to both theſe, and ſhall firſt uſe the common logarithms whoſe ſubtangent is 0,43429.

57 Illuſtrated by examples.

The whole ſubject will be beſt illuſtrated by taking an example of the different queſtions which may be propoſed.

Recollect that the rectangle ACOF is $= 2a$, or $\frac{u^2}{g}$, or E, for a ball of caſt-iron one inch diameter, and if it has the diameter d, it is $\frac{u^2 d}{g}$, or $2\,ad$, or E d.

I. It may be required to determine what will be the ſpace deſcribed in a given time t by a ball ſetting out with a given velocity V, and what will be its velocity v at the end of that time.

Here we have NI : MI=ACOF : BDCA; now NI is the ſubtangent of the logiſtic curve; MI is the difference between the logarithms of OD and OC; that is, the difference between the logarithms of $e+t$ and e; ACOF is $2\,ad$, or $\frac{u^2 d}{g}$, or E d.

Therefore by common logarithms $0{,}43429 : \log. e+t - \log. e = 2\,ad : \text{S}$, = ſpace deſcribed,

or $0{,}43429 : \log. \frac{e+t}{e} = 2\,ad : \text{S}$,

and $\text{S.} = \frac{2\,a\,d}{0{,}43429} \times \log. \frac{e+t}{e}$,

by hyperbolic logarithms $\text{S} = 2ad \times \log. \frac{e+t}{e}$.

Let the ball be a 12 pounder, and the initial velocity be 1600 feet, and the time 20 ſeconds. We muſt firſt find e, which is $\frac{2ad}{\text{V}}$.

Therefore, log. $2a$ - -	+ 3.03236
log. d (4, 5) -	+ 0.65321
log. V. (1600) -	— 3.20412
Log. of 3″,03,=e - -	0.48145
And $e+t$ is 23″,03, of which the log. is	1.36229
from which take the log. of e -	0.48145
remains the log. of $\frac{e+t}{e}$ - - -	0.88084

This muſt be conſidered as a common number by which we are to multiply $\frac{2\,a\,d}{0{,}43429}$.

Therefore add the logarithms of $2ad$	+ 3.68557
log. $\frac{e+t}{e}$ - -	+ 9.94490
log. 0,43429 -	— 9.63778
Log. S. 9833 feet - -	3.99269

For the final velocity,

OD : OC=AC : BD, or $e+t : e = \text{V} : v$.

$23'',03 : 3'',03 = 1600 : 210\frac{1}{2}, = v$.

The ball has therefore gone 3278 yards, and its velocity is reduced from 1600 to 210.

It may be agreeable to the reader to ſee the gradual progreſs of the ball during ſome ſeconds of its motion.

T.	*S.*	*Diff.*	*V.*	*Diff.*
1″	1383		1203	397
2″	2456	1073	964	239
3″	3336	880	804	160
4″	4080	744	690	114
5″	4725	645	604	86
6″	5294	569	537	67

The firſt column is the time of the motion, the ſecond is the ſpace deſcribed, the third is the differences of the ſpaces, ſhowing the motion during each ſucceſſive ſecond; the fourth column is the velocity at the end of the time t; and the laſt column is the differences of velocity, ſhowing its diminution in each ſucceſſive ſecond. We ſee that at the diſtance of 1000 yards the velocity is reduced to one half, and at the diſtance of leſs than a mile it is reduced to one third.

II. It may be required to determine the diſtance at which the initial velocity V is reduced to any other quantity v. This queſtion is ſolved in the very ſame manner, by ſubſtituting the logarithms of V and v for thoſe of $e+t$ and e; for AC : BD=OD : OC, and therefore log. $\frac{AC}{BD}=$ log. $\frac{OD}{OC}$, or log. $\frac{V}{v}=$ log. $\frac{e+t.}{e}$

Thus it is required to determine the diſtance in which the velocity 1780 of a 24 pound ball (which is the medium velocity of ſuch a ball diſcharged with 16 pounds of powder) will be reduced to 1500.

Here d is 5,68, and therefore the logarithm of $2ad$ is - - +3.78671

Log. $\frac{V}{v}=0{,}07433$, of which the log. is +8.87116

Log. 0,43429 - - - —9.63778

Log. 1047,3 feet, or 349 yards 3.02009

This reduction will be produced in about $\frac{7}{8}$ of a ſecond.

III. Another queſtion may be to determine the time which a ball, beginning to move with a certain velocity, employs in paſſing over a given ſpace, and the diminution of velocity which it ſuſtains from the reſiſtance of the air.

We may proceed thus:

$2ad$: S $=0{,}43429$: log. $\frac{e+t}{e}$, $=t$. Then to log. $\frac{e+t}{e}$ add log. e and we obtain log. $e+t$, and $e+t$; from which if we take e we have t. Then to find v, ſay $e+t : e=V : v$.

58 Application of an experiment of Mr Robins. See Robins's Math. Works, vol. i. p. 135. We ſhall conclude theſe examples by applying this laſt rule to Mr Robin's experiment on a muſket bullet of $\frac{3}{4}$ of an inch in diameter, which had its velocity reduced from 1670 to 1425 by paſſing through 100 feet of air. This we do in order to diſcover the reſiſtance which it ſuſtained, and compare it with the reſiſtance to a velocity of 1 foot *per* ſecond.

We muſt firſt aſcertain the firſt term of our analogy. The ball was of lead, and therefore $2a$ muſt be multiplied by d and by m, which expreſſes the ratio of the denſity of lead to that of caſt iron. d is 0,75, and m is $\frac{11{,}37}{7{,}21}=1{,}577$. Therefore log. $2a$ 3.03236

d 9.87506

m 0.19782

Log. $2adm$ 3.10524

and $2adm=1274{,}2$.

Now $1274{,}2 : 100=0{,}43429 : 0{,}03408=$ log. $\frac{e+t}{e}$.

But $e=\frac{2adm}{V}=0{,}763$, and its logarithm=9.88252, which, added to 0.03408, gives 9.91660, which is the log. of $e+t$, $=0{,}825$, from which take e, and there remains $t=,0'',062$, or $\frac{62}{1000}$ of a ſecond, for the time of paſſage. Now, to find the remaining velocity, ſay $825 : ,763=1670 : 1544, =v$.

But in Mr Robins's experiment the remaining velocity was only 1425, the ball having loſt 245; whereas by this computation it ſhould have loſt only 126. It appears, therefore, that the reſiſtance is double of what it would have been if the reſiſtance increaſed in the duplicate proportion of the velocity. Mr Robins ſays it is nearly triple. But he ſuppoſes the reſiſtance to ſlow motions much ſmaller than his own experiment, ſo often mentioned, fully warrants.

The time e, in which the reſiſtance of the air would extinguiſh the velocity is $0',763$. Gravity, or the weight of the bullet, would have done it in $\frac{1670}{32}$ or 52″; therefore the reſiſtance is $\frac{52}{0{,}763}$ times, or nearly 68 times its weight, by this theory, or 5,97 pounds. If we calculate from Mr Robins's experiment, we muſt ſay log. $\frac{V}{v} : 0{,}43429=100 : eV$, which will be 630,23, and $e=\frac{630{,}23}{1670}=0'',3774$, and $\frac{52}{0{,}3774}$ gives 138 for the proportion of the reſiſtance to the weight, and makes the reſiſtance 12,07 pounds, fully double of the other.

It is to be obſerved, that with this velocity, which greatly exceeds that with which the air can ruſh into a void, there muſt be a ſtatical preſſure of the atmoſphere equal to $6\frac{1}{2}$ pounds. This will make up the difference, and allows us to conclude that the reſiſtance ariſing ſolely from the motion communicated to the air follows very nearly the duplicate proportion of the velocity.

The next experiment, with a velocity of 1690 feet, gives a reſiſtance equal to 157 times the weight of the bullet, and this bears a much greater proportion to the former than 1690^2 does to 1670^2; which ſhows, that although theſe experiments clearly demonſtrate a prodigious augmentation of reſiſtance, yet they are by no means ſuſceptible of the preciſion which is neceſſary for diſcovering the law of this augmentation, or for a good foundation of practical rules; and it is ſtill greatly to be wiſhed that a more accurate mode of inveſtigation could be diſcovered.

59 Recapitulation. Thus we have explained, in great detail, the principles and the proceſs of calculation for the ſimple caſe

of the motion of projectiles through the air. The learned reader will think that we have been unreaſonably prolix, and that the whole might have been compriſed in leſs room, by taking the algebraic method. We acknowledge that it might have been done even in a few lines. But we have obſerved, and our obſervation has been confirmed by perſons well verſed in ſuch ſubjects, that in all caſes where the fluxionary proceſs introduces the fluxion of a logarithm, there is a great want of diſtinct ideas to accompany the hand and eye. The ſolution comes out by a ſort of magic or legerdemain, we cannot tell either *how* or *why*. We therefore thought it our duty to furniſh the reader with diſtinct conceptions of the things and quantities treated of. For this reaſon, after ſhowing, in Sir Iſaac Newton's manner, how the ſpaces deſcribed in the retarded motion of a projectile followed the proportion of the hyperbolic areas, we ſhewed the nature of another curve, where lines could be found which increaſe in the very ſame manner as the path of the projectile increaſes; ſo that a point deſcribing the abſciſſa MI of this curve moves preciſely as the projectile does. Then, diſcovering that this line is the ſame with the line of logarithms on a Gunter's ſcale, we ſhewed how the logarithm of a number really repreſents the path or ſpace deſcribed by the projectile. And we were the more diſpoſed to do this, becauſe in the articles LOGARITHMS and *LOGARITHMIC Curve*, there has not been that notice taken of it which would have been proper.

Having thus, we hope, enabled the reader to conceive diſtinctly the quantities employed, we ſhall leave the geometrical method, and proſecute the reſt of the ſubject in a more compendious manner.

60 Of the perpendicular aſcents of heavy projectiles. We are, in the next place, to conſider the perpendicular aſcents and deſcents of *heavy* projectiles, where the reſiſtance of the air is combined with the action of gravity: and we ſhall begin with the deſcents.

Let u, as before, be the terminal velocity, and g the accelerating power of gravity: When the body moves with the velocity u, the reſiſtance is equal to g; and in every other velocity v, we muſt have $u^2 : v^2 = g : \frac{gv^2}{u^2}, = r$, for the reſiſtance to that velocity. In the deſcent the body is urged by gravity g, and oppoſed by the reſiſtance $\frac{gv^2}{u^2}$: therefore the remaining accelerating force, which we ſhall call f, is $g - \frac{gv^2}{u^2}$, or $\frac{gu^2 - gv^2}{u^2}$, or $\frac{g(u^2 - v^2)}{u^2}, = f$.

Now the fundamental theorem for varied motions is $f\dot{s} = u\dot{v}$, and $\dot{s} = \frac{v\dot{v}}{f}, = \frac{u^2}{g} \times \frac{v\dot{v}}{u^2 - v^2}$, and $s = \frac{u^2}{g} \times \int \frac{v\dot{v}}{u^2 - v^2} + C$. Now the fluent of $\frac{v\dot{v}}{u^2 - v^2}$ is $=$ — hyperb. log of $\sqrt{u^2 - v^2}$. For the fluxion of $\sqrt{u^2 - v^2}$ is $\frac{-v\dot{v}}{\sqrt{u^2 - v^2}}$, and this divided by the quantity $\sqrt{u^2 - v^2}$, of which it is the fluxion, gives preciſely $\frac{v\dot{v}}{u^2 - v^2}$, which is therefore the fluxion of its hyperbolic logarithm. Therefore $S = -\frac{u^2}{g} \times L\sqrt{u^2 - v^2} + C$. Where L means the hyperbolic logarithm of the quantity annexed to it, and λ may be uſed to expreſs its common logarithm. (See article FLUXIONS).

The conſtant quantity C for completing the fluent is determined from this conſideration, that the ſpace deſcribed is o, when the velocity is o: therefore $C - \frac{u^2}{g} \times L\sqrt{u^2} = o$, and $C = \frac{u^2}{g} \times L\sqrt{u^2}$, and the complete fluent $S = \frac{u^2}{g} \times \overline{L\sqrt{u^2} - L\sqrt{u^2 - v^2}}$, $= \frac{u^2}{g} \times L\sqrt{\frac{u^2}{u^2 - v^2}}. = \frac{u^2}{0{,}43429g} \times \lambda\sqrt{\frac{u^2}{u^2 - v^2}}$, or (putting M for 0,43429, the modulus or ſubtangent of the common logiſtic curve) $= \frac{u^2}{Mg} \times \lambda\sqrt{\frac{u^2}{u^2 - v^2}}$.

This equation eſtabliſhes the relation between the ſpace fallen through, and the velocity acquired by the fall. We obtain by it $\frac{gS}{u^2} = L\sqrt{\frac{u^2}{u^2 - v^2}}$, and $\frac{2gS}{u^2} = L.\frac{u^2}{u^2 - v^2}$, or, which is ſtill more convenient for us, $\frac{M \times 2gS}{u^2} = \lambda\frac{u^2}{u^2 - v^2}$, that is, equal to the logarithm of a certain number: therefore having found the natural number correſponding to the fraction $\frac{M \times 2gS}{u^2}$, conſider it as a logarithm, and take out the number correſponding to it: call this n. Then, ſince n is equal to $\frac{u^2}{u^2 - v^2}$, we have $nu^2 - nv^2 = u^2$, and $nu^2 - u^2 = nv^2$, or $nv^2 = u^2 \times \overline{n - v}$, and $v^2 = \frac{u^2 \times \overline{n-1}}{n}$.

To expedite all the computations on this ſubject, it will be convenient to have multipliers ready computed for $M \times 2g$, and its half,

viz. 27,794, whoſe log. is - - 1.44396
and 13,897 - - - 1.14293

But v may be found much more expeditiouſly by obſerving that $\sqrt{\frac{u^2}{u^2 - v^2}}$ is the ſecant of an arch of a circle whoſe radius is u, and whoſe ſine is v, or whoſe radius is unity and ſine $= \frac{v}{u}$: therefore, conſidering the above fraction as a logarithmic ſecant, look for it in the tables, and then take the ſine of the arc of which this is the ſecant, and multiply it by u; the product is the velocity required.

We ſhall take an example of a ball whoſe terminal velocity is 689$\frac{1}{3}$ feet, and aſcertain its velocity after a fall of 1848 feet. Here,

$u^2 = 475200$ and its log. - $= 5.67688$
$u = 689\frac{1}{3}$ - - - 2.83844
$g = 32$ - - - 1.50515
$S = 1848$ - - - 3.26670

Then log. 27,794 - - - + 1.44396
log. S - - - + 3.26670
log. u^2 - - - — 5.67688

Log. of 0,10809 = log. n - 9.03378
0,10809 is the logarithm of 1,2826 = n, and $n-1$ = 0,2826, and $\frac{u^2 \times \overline{n-1}}{n} = 323,6^2, = v^2$, and v = 323,6.

In like manner, 0,054045 (which is half of 0,10809) will be found to be the logarithmic ſecant of 28°, whoſe ſine 0,46947 multiplied by 689$\frac{1}{3}$ gives 324 for the velocity.

The proceſs of this ſolution ſuggeſts a very perſpicuous manner of conceiving the law of deſcent; and it may be thus expreſſed:

M is to the logarithm of the ſecant of an arch whoſe ſine is $\frac{v}{u}$, and radius 1, as 2 a is to the height through which the body muſt fall in order to acquire the velocity v. Thus, to take the ſame example.

1. Let the height h be ſought which will produce the velocity 323,62, the terminal velocity of the ball being 689,34. Here 2 a, or $\frac{u^2}{g}$ is 14850, and $\frac{323,62}{689,34}$ = 0,46947, which is the ſine of 28°. The logarithmic ſecant of this arch is 0,05407. Now M or 0,43429 : 0,05407 = 14850 : 1848, the height wanted.

2. Required the velocity acquired by the body by falling 1848 feet. Say 14850 : 1848 = 0,43429 : 0,05407. Look for this number among the logarithmic ſecants. It will be found at 28°, of which the logarithmic ſine is - - - - 9.67161
Add to this the log. of u - - 2.83844
The ſum - - - 2.51005
is the logarithm of 323,62, the velocity required.

61 Erroneous aſſertion of Mr Muller,

We may obſerve, from theſe ſolutions, that the acquired velocity continually approaches to, but never equals, the terminal velocity. For it is always expreſſed by the ſine of an arch of which the terminal velocity is the radius. We cannot help taking notice here of a very ſtrange aſſertion of Mr Muller, late profeſſor of mathematics and director of the royal academy at Woolwich. He maintains, in his Treatiſe on Gunnery, his Treatiſe on Fluxions, and in many of his numerous works, that a body cannot poſſibly move through the air with a greater velocity than this; and he makes this a fundamental principle, on which he eſtabliſhes a theory of motion in a reſiſting medium, which he aſſerts with great confidence to be the only juſt theory; ſaying, that all the inveſtigations of Bernoulli, Euler, Robins, Simpſon, and others, are erroneous. We uſe this ſtrong expreſſion, becauſe, in his criticiſms on the works of thoſe celebrated mathematicians, he lays aſide good manners, and taxes them not only with ignorance, but with diſhoneſty; ſaying, for inſtance, that it required no ſmall dexterity in Robins to confirm by his experiments a theory founded on falſe principles; and that Thomas Simpſon, in attempting to conceal his obligations to him for ſome valuable propoſitions, by changing their form, had ignorantly fallen into groſs errors.

Nothing can be more palpably abſurd than this aſſertion of Mr Muller. A blown bladder will have but a ſmall terminal velocity; and when moving with this velocity, or one very near it, there can be no doubt that it will be made to move much ſwifter by a ſmart ſtroke. Were the aſſertion true, it would be impoſſible for a portion of air to be put into motion through the reſt, for its terminal velocity is nothing. Yet this author makes this aſſertion a principle of argument, ſaying, that it is impoſſible that a ball can iſſue from the mouth of a cannon with a greater velocity than this; and that Robins and others are groſsly miſtaken, when they give them velocities three or four times greater, and reſiſtances which are 10 or 20 times greater than is poſſible; and by thus compenſating his ſmall velocities by ſtill ſmaller reſiſtances, he confirms his theory by many experiments adduced in ſupport of the others. No reaſon whatever can be given for the aſſertion. Newton, or perhaps Huygens, was the firſt who obſerved that there was a limit to the velocity which gravity could communicate to a body; and this limit was found by his commentators to be a term to which it was vaſtly convenient to refer all its other motions. It therefore became an object of attention; and Mr Muller, through inadvertency, or want of diſcernment, has fallen into this miſtake, and with that arrogance and ſelf-conceit which mark all his writings, has made this miſtake a fundamental principle, becauſe it led him to eſtabliſh a novel ſet of doctrines on this ſubject. He was fretted at the ſuperior knowledge and talents of Mr Simpſon, his inferior in the academy, and was guilty of ſeveral mean attempts to hurt his reputation. But they were unſucceſsful.

62 Motion of a body projected downwards.

We might proceed to conſider the motion of a body projected downwards. While the velocity of projection is leſs than the terminal velocity, the motion is determined by what we have already ſaid: for we muſt compute the height neceſſary for acquiring this velocity in the air, and ſuppoſe the motion to have begun there. But if the velocity of projection be greater, this method fails. We paſs it over (though not in the leaſt more difficult than what has gone before), becauſe it is of mere curioſity, and never occurs in any intereſting caſe. We may juſt obſerve, that ſince the motion is ſwifter than the terminal velocity, the reſiſtance muſt be greater than the weight, and the motion will be retarded. The very ſame proceſs will give us for the ſpace deſcribed $S = \frac{u^2}{g} \times L \sqrt{\frac{V^2 - u^2}{v^2 - u^2}}$, V being the velocity of projection, greater than u. Now as this ſpace evidently increaſes continually (becauſe the body always falls), but does not become infinite in any finite time, the fraction $\frac{V^2 - u^2}{v^2 - u^2}$ does not become infinite; that is, v^2 does not become equal to u^2: therefore although the velocity V is continually diminiſhed, it never becomes ſo ſmall as u. Therefore u is a limit of diminution as well as of augmentation.

63 Relation between the time of deſcent and ſpace deſcribed, &c.

We muſt now aſcertain the relation between the time of the deſcent and the ſpace deſcribed, or the velocity acquired. For this purpoſe we may uſe the other fundamental propoſition of varied motions $f\dot{t} = \dot{v}$, which, in the preſent caſe, becomes $\frac{g\overline{u^2 - v^2}}{n^2}\dot{t} = \dot{v}$; therefore $\dot{t} =$

u^2

$\frac{u^2}{g}\times\frac{\dot{v}}{u^2-v^2}, =\frac{u}{g}\times\frac{u\dot{v}}{u^2-v^2}$, and $t=\frac{u}{g}\times\int\frac{u\dot{v}}{u^2-v^2}$. Now (art. Fluxions) $\int\frac{u\dot{v}}{u^2-v^2}=L\sqrt{\frac{u+v}{u-v}}$. Therefore $t=\frac{u}{g}\times L\sqrt{\frac{u+v}{u-v}},=\frac{u}{Mg}\times\lambda\sqrt{\frac{u+v}{u-v}}$. This fluent needs no conſtant quantity to complete it, or rather $C=o$; for t muſt be $=o$ when $v=o$. This will evidently be the caſe: for then $L\sqrt{\frac{u+v}{u-v}}$ is $L\sqrt{\frac{u}{u}},=L\ 1,=0$.

But how does this quantity $\frac{u}{Mg}\times\lambda\sqrt{\frac{u+v}{u-v}}$ ſignify a time? Obſerve, that in whatever numbers, or by whatever units of ſpace and time, u and g are expreſſed, $\frac{u}{g}$ expreſſes the number of units of time in which the velocity u is communicated or extinguiſhed by gravity; and $L\sqrt{\frac{u+v}{u-v}}$, or $\frac{\lambda}{M}\sqrt{\frac{u+v}{u-v}}$, is always an abſtract number, multiplying this time.

We may illuſtrate this rule by the ſame example. In what time will the body acquire the velocity 323,62? Here $u+v=1012,96$, $u-v=365,72$; therefore $\lambda\sqrt{\frac{u+v}{u-v}}=0,22122$, and $\frac{u}{g}$ (in feet and ſeconds) is 21″, 542. Now, for greater perſpicuity, convert the equation $t=\frac{u}{Mg}\times\lambda\sqrt{\frac{u+v}{u-v}}$ into a proportion: thus $M:\lambda\sqrt{\frac{u+v}{u-v}}=\frac{u}{g}:t$, and we have 0,43429 : 0,22122 = 21″,542 : 10″,973, the time required.

This is by far the moſt diſtinct way of conceiving the ſubject; and we ſhould always keep in mind that the numbers of ſymbols which we call logarithms are really parts of the line MI in the figure of the logiſtic curve, and that the motion of a point in this line is preciſely ſimilar to that of the body. The Marquis Poleni, in a diſſertation publiſhed at Padua in 1725, has with great ingenuity conſtructed logarithmics ſuited to all the caſes which can occur. Herman, in his *Phoronomia*, has borrowed much of Poleni's methods, but has obſcured them by an affectation of language geometrically preciſe, but involving the very obſcure notion of abſtract ratios.

It is eaſy to ſee that $\sqrt{\frac{u+v}{u-v}}$ is the cotangent of the $\frac{1}{2}$ complete of an arch, whoſe radius is 1, and whoſe ſine is $\frac{v}{u}$: For let KC (fig 6.) be $=u$, and BE$=v$; then KD$=u+v$, and DA$=u-v$. Join KB and BA, and draw CG parallel to KB. Now GA is the tangent of $\frac{1}{2}$ BA, $=\frac{1}{2}$ complement of HB. Then, by ſimilarity of triangles, GA : AC = AB : BK, $=\sqrt{\overline{AD}}:\sqrt{\overline{DK}}=\sqrt{u-v}:\sqrt{u+v}$ and $\frac{AC}{GA}$ (= cotan. $\frac{1}{2}$BA) $=\sqrt{\frac{u+v}{u-v}}$; therefore look for $\frac{v}{u}$ among the natural ſines, or for log. $\frac{u}{v}$ among the logarithmic ſines, and take the logarithmic cotangent of the half complement of the correſponding arch. This, conſidered as a common number, will be the ſecond term of our proportion. This is a ſhorter proceſs than the former.

Plate CCCCXVII.

By reverſing this proportion we get the velocity correſponding to a given time.

64 Fall of a body in air compared with that of one in vacuo.

To compare this deſcent of 1848 feet in the air with the fall of the body *in vacuo* during the ſame time, ſay $\overline{21'',542}^2 : \overline{10'',973}^2 = 1848 : 1926,6$, which makes a difference of 79 feet.

Cor. 1. The time in which the body acquires the velocity u by falling through the air, is to the time of acquiring the ſame velocity by falling *in vacuo*, as u. $L\sqrt{\frac{u+v}{u-v}}$ to v: for it would acquire this velocity *in vacuo* during the time $\frac{v}{g}$, and it acquires it in the air in the time $\frac{u}{g}L\sqrt{\frac{u+v}{u-v}}$.

2. The velocity which the body acquires by falling through the air in the time $\frac{u}{g}L\sqrt{\frac{u+v}{u-v}}$, is to the velocity which it would acquire *in vacuo* during the ſame time, as v to $u\,L\sqrt{\frac{u+v}{u-v}}$: For the velocity which it would acquire *in vacuo* during the time $\frac{u}{g}L\sqrt{\frac{u+v}{u-v}}$ muſt be $uL\sqrt{\frac{u+v}{u-v}}$ (becauſe in any time $\frac{w}{g}$ the velocity w is acquired).

65 Time of the aſcent of a body projected perpendicularly.

In the next place, let a body, whoſe terminal velocity is u, be projected perpendicularly upwards, with any velocity V. It is required to determine the height to which it aſcends, ſo as to have any remaining velocity v, and the time of its aſcent; as alſo the height and time in which its whole motion will be extinguiſhed.

We have now $\frac{g(u^2+v^2)}{u^2}$ for the expreſſion of f; for both gravity and reſiſtance act now in the ſame direction and retard the motion of the aſcending body: therefore $\frac{g(u^2+v^2)}{u^2}\dot{s}=-v\dot{v}$, and $\dot{s}=-\frac{u^2}{g}\times\frac{v\dot{v}}{u^2+v^2}$, and $s=-\frac{u^2}{g}\times\int\frac{v\dot{v}}{u^2+v^2}+C,=-\frac{u^2}{g}\times L\sqrt{u^2+v^2}+C$ (ſee art. Fluxions). This muſt be $=o$ at the beginning of the motion, that is, when $v=V$, that is, $-\frac{u^2}{g}\times L\sqrt{u^2+V^2}+C=o$, or $C=\frac{u^2}{g}\times L\sqrt{u^2+V^2}$, and the complete fluent will be $s=\frac{u^2}{g}\times\left(L\sqrt{u^2+V^2}-L\sqrt{u^2+v^2}\right)=\frac{u^2}{g}\times L\sqrt{\frac{u^2+V^2}{u^2+v}},=\frac{u^2}{Mg}\times\lambda\sqrt{\frac{u^2+V^2}{u^2+v^2}}$

Let h be the greateſt height to which the body will riſe. Then $s=h$ when $v=o$; and $h=\frac{u^2}{g}\times L\sqrt{\frac{u^2+V^2}{u^2}},=\frac{u^2}{Mg}\times\lambda\sqrt{\frac{u^2+V^2}{u^2}}$. We have $\lambda\sqrt{\frac{u^2+V^2}{u^2+v^2}}=s\frac{mg}{u^2}$; therefore $\lambda\left(\frac{u^2+V^2}{u^2+v^2}\right)=\frac{2Mgs}{u^2}$

Therefore let n be the number whoſe common logarithm is $\frac{2Mgs}{u^2}$; we ſhall have $n=\frac{u^2+V^2}{u^2+v^2}$, and $v^2=\frac{u^2+V^2}{n}-u^2$; and thus we obtain the relation of s and v, as in the caſe of deſcents: but we obtain it ſtill eaſier by obſerving that $\sqrt{u^2+V^2}$ is the ſecant of an arch whoſe radius is u, and whoſe tangent is V, and that $\sqrt{u^2+v^2}$ is the ſecant of another arch of the ſame circle, whoſe tangent is v.

Let the ſame ball be projected upwards with the velocity 411,05 feet per ſecond. Required the whole height to which it will riſe?

Here $\frac{V}{u}$ will be found the tangent of $30.48\frac{1}{3}$, the logarithmic ſecant of which is 0,06606. This, multiplied by $\frac{u^2}{Mg}$, gives 2259 feet for the height. It would have riſen 2640 feet in a void.

66 Velocity of projection compared with that with which it reaches the ground. Suppoſe this body to fall down again. We can compare the velocity of projection with the velocity with which it again reaches the ground. The aſcent and deſcent are equal: therefore $\sqrt{\frac{u^2+V^2}{u^2}}$, which multiplies the conſtant factor in the aſcent, is equal to $\sqrt{\frac{u^2}{u^2-v^2}}$, the multiplier in the deſcent. The firſt is the ſecant of an arch whoſe tangent is V; the other is the ſecant of an arch whoſe ſine is v. Theſe ſecants are equal, or the arches are the ſame; therefore the velocity of projection is to the final returning velocity as the tangent to the ſine, or as the radius to the coſine of the arch. Thus ſuppoſe the body projected with the terminal velocity, or $V=u$; then $v=\frac{u}{\sqrt{2}}$. If $V=689$, $v=487$.

We muſt in the laſt place aſcertain the relation of the ſpace and the time.

Here $\frac{g(u^2+v^2)}{u^2}\dot{t}=-\dot{v}$, and $\dot{t}=-\frac{u^2}{g}\times\frac{\dot{v}}{u^2+v^2},=-\frac{u}{g}\times\frac{u\dot{v}}{u^2+v^2}$; and $t=\frac{-u}{g}\times\int\frac{u\dot{v}}{u^2+v^2}+C$. Now (art. Fluxions) $\int\frac{u\dot{v}}{u^2+v^2}$ is an arch whoſe tangent $=\frac{v}{u}$ and radius 1; therefore $t=-\frac{u}{g}\times$ arc. tan. $\frac{v}{u}+C$. This muſt be $=0$ when $v=V$, or $C-\frac{u}{g}\times$ arc. tan. $\frac{V}{u}=0$, and $C=\frac{u}{g}\times$ arc. tan. $\frac{V}{u}$, and the complete fluent is $t=\frac{u}{g}\times\left(\text{arc. tan.}\frac{V}{u}-\text{arc. tan.}\frac{v}{u}\right)$ The quantities within the brackets expreſs a portion of the arch of a circle whoſe radius is unity; and are therefore abſtract numbers, multiplying $\frac{u}{g}$, which we have ſhown to be the number of units of time in which a heavy body falls *in vacuo* from the height a, or in which it acquires the velocity u.

67 Time of aſcent limited. We learn from this expreſſion of the time, that however great the velocity of projection, and the height to which this body will riſe, may be, the time of its aſcent is limited. It never can exceed the time of falling from the height *a in vacuo* in a greater proportion than that of a quadrantal arch to the radius, nearly the proportion of 8 to 5. A 24 pound iron ball cannot continue riſing above 14 ſeconds, even if the reſiſtance to quick motions did not increaſe faſter than the ſquare of the velocity. It probably will attain its greateſt height in leſs than 12 ſeconds, let its velocity be ever ſo great.

In the preceding example of the whole aſcent, $v=0$, and the time $t=\frac{u}{g}\times$ arc. tan. $\frac{V}{u}$, or $\frac{u}{g}$ arc. 30°.48′. Now 30°. 48′ = 1848′, and the radius 1 contains 3438; therefore the arch $=\frac{1848}{3438},=0,5376$; and $\frac{u}{g}=21'',54$. Therefore $t=21'',54\times0,5376,=11'',58$, or nearly $11\frac{1}{2}$ ſeconds. The body would have riſen to the ſame height in a void in $10\frac{3}{4}$ ſeconds.

68 This time compared in bodies projected in air and in vacuo. *Cor.* 1. The time in which a body, projected in the air with any velocity V, will attain its greateſt height, is to that in which it would attain its greateſt height *in vacuo*, as the arch whoſe tangent expreſſes the velocity is to the tangent; for the time of the aſcent in the air is $\frac{u}{g}\times$ arch; the time of the aſcent *in vacuo* is $\frac{V}{g}$. Now $\frac{V}{u}$ is = tan. and $V=u\times$ tan. and $\frac{V}{g}=\frac{u}{g}\times$ tan.

Plate CCCCXVII It is evident, by inſpecting fig. 6. that the arch AI is to the tangent AG as the ſector ICA to the triangle GCA; therefore the time of attaining the greateſt height in the air is to that of attaining the greateſt height *in vacuo* (the velocities of projection being the ſame), as the circular ſector to the correſponding triangle.

If therefore a body be projected upwards with the terminal velocity, the time of its aſcent will be to the time of acquiring this velocity *in vacuo* as the area of a circle to the area of the circumſcribed ſquare.

2. The height H to which a body will riſe in a void, is to the height h to which it would riſe through the air when projected with the ſame velocity V as $M\cdot V^2$ to $u^2\times\lambda\frac{u^2+V^2}{u^2}$: for the height to which it will riſe *in vacuo* is $\frac{V^2}{2g}$, and the height to which it riſes in the air is $\frac{u^2}{Mg}\lambda\sqrt{\frac{u^2+V^2}{u^2}}$; therefore $H:h=\frac{V^2}{2g}:\frac{u^2}{Mg}\lambda\sqrt{\frac{u^2+V^2}{u^2}},=V^2:\frac{u^2}{M}\times2\lambda\sqrt{\frac{u^2+V^2}{u^2}},=V^2:\frac{u^2}{M}\times\lambda\frac{u^2+V^2}{u^2},=M\cdot V^2:u^2\times\lambda\frac{u^2+V^2}{u^2}$.

Therefore if the body be projected with its terminal velocity, ſo that $V=u$, the height to which it will riſe in the air is $\frac{30103}{43429}$ of the height to which it will riſe *in vacuo*, or $\frac{5}{7}$ in round numbers.

We have been thus particular in treating of the perpendicular aſcents and deſcents or heavy bodies through the air, in order that the reader may conceive diſtinctly the quantities which he is thus combining in his algebraic operations, and may ſee their connection in nature with each other. We ſhall alſo find that, in the preſent ſtate of our mathematical knowledge, this ſimple ſtate of the caſe contains almoſt all that we can determine with any confidence. On this account it were to be wiſhed that the profeſſional gentlemen would make many experiments on theſe motions. There is no way that promiſes ſo much for aſſiſting us in forming accurate notions of the air's reſiſtance. Mr Robins's method with the pendulum is impracticable with great ſhot; and the experiments which have been generally reſorted to for this purpoſe, viz. the ranges of ſhot and ſhells on a horizontal plane, are ſo complicated in themſelves, that the utmoſt mathematical ſkill is neceſſary for making any inferences from them; and they are ſubject to ſuch irregularities, that they may be brought to ſupport almoſt any theory whatever on this ſubject. But the perpendicular flights are affected by nothing but the initial velocity and the reſiſtance of the air; and a conſiderable deviation from their intended direction does not cauſe any ſenſible error in the conſequences which we may draw from them for our purpoſe.

69 Neceſſity of further experiments.

70 Of oblique projection.

But we muſt now proceed to the general problem, to determine the motion of a body projected in any direction, and with any velocity. Our readers will believe beforehand that this muſt be a difficult ſubject, when they ſee the ſimpleſt caſes of rectilineal motion abundantly abſtruſe: it is indeed ſo difficult, that Sir Iſaac Newton has not given a ſolution of it, and has thought himſelf well employed in making ſeveral approximations, in which the fertility of his genius appears in great luſtre. In the tenth and ſubſequent propoſitions of the ſecond book of the *Principia*, he ſhows what ſtate of denſity in the air will comport with the motion of a body in any curve whatever: and then, by applying this diſcovery to ſeveral curves which have ſome ſimilarity to the path of a projectile, he finds one which is not very different from what we may ſuppoſe to obtain in our atmoſphere. But even this approximation was involved in ſuch intricate calculations, that it ſeemed impoſſible to make any uſe of it. In the ſecond edition of the *Principia*, publiſhed in 1713, Newton corrects ſome miſtakes which he had committed in the firſt, and carries his approximations much farther, but ſtill does not attempt a direct inveſtigation of the path which a body will deſcribe in our atmoſphere. This is ſomewhat ſurpriſing. In prop. 14. &c. he ſhows how a body, actuated by a centripetal force, in a medium of a denſity varying according to certain laws, will deſcribe an eccentric ſpiral, of which he aſſigns the properties, and the law of deſcription. Had he ſuppoſed the denſity conſtant, and the difference between the greateſt and leaſt diſtances from the centre of centripetal force exceedingly ſmall in compariſon with the diſtances themſelves, his ſpiral would have coincided with the path of a projectile in the air of uniform denſity, and the ſteps of his inveſtigation would have led him immediately to the complete ſolution of the problem. For this is the real ſtate of the caſe. A heavy body is not acted on by equal and parallel gravity, but by a gravity inverſely proportional to the ſquare of the diſtance from the centre of the earth, and in lines tending to that centre nearly; and it was with the view of ſimplifying the inveſtigation, that mathematicians have adopted the other hypotheſis.

71 This problem not ſolved by Newton.

72 Diſputes among Britiſh and foreign mathematicians.

Soon after the publication of this ſecond edition of the *Principia*, the diſpute about the invention of the fluxionary calculus became very violent, and the great promoters of that calculus upon the continent were in the habit of propoſing difficult problems to exerciſe the talents of the mathematician. Challenges of this kind frequently paſſed between the Britiſh and foreigners. Dr Keill of Oxford had keenly eſpouſed the claim of Sir Iſaac Newton to this invention, and had engaged in a very acrimonious altercation with the celebrated John Bernoulli of Baſle. Bernoulli had publiſhed in the *Acta Eruditorum Lipſiæ* an inveſtigation of the law of forces, by which a body moving in a reſiſting medium might deſcribe any propoſed curve, reducing the whole to the ſimpleſt geometry. This is perhaps the moſt elegant ſpecimen which he has given of his great talents. Dr Keill propoſed to him the particular problem of the trajectory and motion of a body moving through the air, as one of the moſt difficult. Bernoulli very ſoon ſolved the problem in a way much more general than it had been propoſed, viz. without any limitation either of the law of reſiſtance, the law of the centripetal force, or the law of denſity, provided only that they were regular, and capable of being expreſſed algebraically. Dr Brooke Taylor, the celebrated author of the Method of Increments, ſolved it at the ſame time, in the limited form in which it was propoſed. Other authors ſince that time have given other ſolutions. But they are all (as indeed they muſt be) the ſame in ſubſtance with Bernoulli's. Indeed they are all (Bernoulli's not excepted) the ſame with Newton's firſt approximations, modified by the ſteps introduced into the inveſtigation of the ſpiral motions mentioned above; and we ſtill think it moſt ſtrange that Sir Iſaac did not perceive that the *variation of curvature*, which he introduced into that inveſtigation, made the whole difference between his approximations and the complete ſolution. This we ſhall point out as we go along. And we now proceed to the problem itſelf, of which we ſhall give Bernoulli's ſolution, reſtricted to the caſe of uniform denſity and a reſiſtance proportional to the ſquare of the velocity. This ſolution is more ſimple and perſpicuous than any that has ſince appeared.

73 Bernoulli's ſolution.

Problem. To determine the trajectory, and all the circumſtances of the motion, of a body projected thro' the air from A (fig. 7.) in the direction AB, and reſiſted in the duplicate ratio of the velocity.

Plate CCCCXVII.

Let the arch AM be put $= z$, the time of deſcribing it t, the abſciſſa AP $= x$, the ordinate PM $= y$. Let the velocity in the point M $= v$, and let MN, $= \dot{z}$, be deſcribed in the moment $\dot{t}$; let r be the reſiſtance of the air, g the force of gravity, meaſured by the velocity which it will generate in a ſecond; and let a be the height through which a heavy body muſt fall *in vacuo* to acquire the velocity which would render the reſiſtance of the air equal to its gravity: ſo that we have $r = \frac{v^2}{2a}$; becauſe, for any velocity u, and producing height h, we have $g = \frac{u^2}{2h}$

Let Mm touch the curve in M; draw the ordinate

p Nm, and draw Mo, Nn perpendicular to Np and Mm. Then we have MN$=\dot z$, and M$o=\dot x$, alſo mo is ultimately $=\dot y$ and Mm is ultimately $=$ MN or $\dot z$. Laſtly, let us ſuppoſe $\dot x$ to be a conſtant quantity, the elementary ordinates being ſuppoſed equidiſtant.

74 Action of gravity in given ime.

The action of gravity during the time $\dot t$ may be meaſured by mN, which is half the ſpace which it would cauſe the body to deſcribe uniformly in the time $\dot t$ with the velocity which it generates in that time. Let this be reſolved into nN, by which it deflects the body into a curvilineal path, and mn, by which it retards the aſcent and accelerates the deſcent of the body along the tangent. The reſiſtance of the air acts ſolely in retarding the motion, both in aſcending and deſcending, and has no deflective tendency. The whole action of gravity then is to its accelerating or retarding tendency as mN to mn, or (by ſimilarity of triangles) as mM to mo. Or $\dot z : \dot y = g : \frac{g\dot y}{\dot z}$, and the whole retardation in the aſcent will be $r + \frac{g\dot y}{\dot z}$. The ſame fluxionary ſymbol will expreſs the retardation during the deſcent, becauſe in the deſcent the ordinates decreaſe, and $\dot y$ is a negative quantity.

The diminution of velocity is $-\dot v$. This is proportional to the retarding force and to the time of its action jointly, and therefore $-\dot v = \overline{r + \frac{g\dot y}{\dot z}} \times \dot t$; but the time $\dot t$ is as the ſpace $\dot z$ divided by the velocity v; therefore $-\dot v = r + \frac{g\dot y}{\dot z} \times \frac{\dot z}{v}, = -\frac{r\dot z + g\dot y}{v}$, and $-v\dot v = -r\dot z - g\dot y, = \frac{v^2\dot z}{2a} - g\dot y$. Becauſe mN is the deflection by gravity, it is as the force g and the ſquare of the time $\dot t$ jointly (the momentary action being held as uniform). We have therefore mN, or $-\ddot y = g\dot t^2$. Obſerve that mN is in fact only the half of $-\ddot y$; but g being twice the fall of a heavy body in a ſecond, we have $-\ddot y$ ſtrictly equal to $g\dot t^2$). But $\dot t^2 = \frac{\dot z^2}{v^2}$; therefore $-\ddot y = \frac{g\dot z^2}{v^2}$, and $v^2 = \frac{g\dot z^2}{-\ddot y}$, and $-v^2\ddot y = g\dot z^2$. The fluxion of this equation is $-v^2\dddot y - 2v\ddot y\dot v = 2g\dot z\ddot z$; but, becauſe $\dot z : \dot y = m$M$: mo, = mN : mn, = \ddot y : \ddot z$, we have $\dot z\ddot z = \dot y\ddot y$. Therefore $2g\dot y\ddot y = 2g\dot z\ddot z, = -v^2\dddot y - 2v\ddot y\dot v$, and $-2v\dot v\ddot y = v^2\dddot y, -2g\dot y\ddot y$, and $-v\dot v = \frac{v^2\dddot y}{2\ddot y} - g\dot y$. But we have already $-v\dot v = \frac{v^2\dot z}{2a} - g\dot y$; therefore $\frac{v^2\dddot y}{\ddot y} = \frac{v^2\dot z}{a}$, and finally $\frac{\dddot y}{\ddot y} = \frac{\dot z}{a}$, or $a\dddot y = \dot z\ddot y$, for the fluxionary equation of the curve.

75 Relation between the length of the curve and its variation of curvature.

If we put this into the form of a proportion, we have $a : \dot z = \ddot y : \dddot y$. Now this evidently eſtabliſhes a relation between the length of the curve and its variation of curvature; and between the curve itſelf and its evoluta, which are the very circumſtances introduced by Newton into his inveſtigation of the ſpiral motions. And the equation $\frac{\dot z}{a} = \frac{\dddot y}{\ddot y}$ is evidently an equation connected with the logarithmic curve and the logarithmic ſpiral. But we muſt endeavour to reduce it to a lower order of fluxions, before we can eſtabliſh a relation between z, x, and y.

Let p expreſs the ratio of $\dot y$ to $\dot x$, that is, let p be $= \frac{\dot y}{\dot x}$, or $p\dot x = \dot y$. It is evident that this expreſſes the inclination of the tangent at M to the horizon, and that p is the tangent of this inclination, radius being unity. Or it may be conſidered merely as a number, multiplying $\dot x$, ſo as to make it $= \dot y$. We now have $\dot y^2 = p^2\dot x^2$, and ſince $\dot z^2 = \dot x^2 + \dot y^2$, we have $\dot z^2 = \dot x^2 + p^2\dot x^2$, $= \overline{1+p^2} \times \dot x^2$ and $\dot z = \dot x\sqrt{1+p^2}$.

Moreover, becauſe we have ſuppoſed the abſciſſa x to increaſe uniformly, and therefore $\dot x$ to be conſtant, we have $\ddot y = \dot x\dot p$, and $\dddot y = \dot x\ddot p$. Now let q expreſs the ratio of $\dot p$ to $\dot x$, that is, make $\frac{\dot p}{\dot x} = q$, or $q\dot x = \dot p$. This gives us $\dot x\dot q = \ddot p$, and $\dot x^2\dot q = \dot x\ddot p, = \dddot y$.

By theſe ſubſtitutions our former equation $a\dddot y = \dot z\ddot y$ changes to $a\dot x^2\dot q = \dot x\sqrt{1+p^2}\,\dot x\dot p$, or $a\dot q = \dot p\sqrt{1+p^2}$, and, taking the fluent on both ſides, we have $aq = \int\dot p\sqrt{1+p^2} + C$, C being the conſtant quantity required for completing the fluent according to the limiting conditions of the caſe. Now $\dot x = \frac{\dot p}{q}$, and $\frac{1}{q} = \frac{a}{\int,\dot p\sqrt{1+p^2}+C}$. Therefore $\dot x = \frac{a\dot p}{\int,\dot p\sqrt{1+\;}+C}$

Alſo, ſince $\dot y = p\dot x, = \frac{p\dot p}{q}$, we have $\dot y = \frac{ap\dot p}{\int,\dot p\sqrt{1+p^2}+C}$

Alſo $\dot z = \dot x\sqrt{1+p^2} = \frac{a\dot p\sqrt{1+p^2}}{\int,\dot p\sqrt{1+p^2}+C}$

The values of $\dot x$, $\dot y$, $\dot z$, give us

$$x = \int\frac{a\dot p}{\int,\dot p\sqrt{1+p^2}+C}, = a\int\frac{\dot p}{\int\dot p\sqrt{1+p^2}+C}.$$

$$y = \int \frac{ap\dot{p}}{\int,\dot{p}\sqrt{1+p^2}|+C}, = a\int\frac{p\dot{p}}{\int,\dot{p}\sqrt{1+p^2}|+C}.$$

$$z = \int,\frac{a\sqrt{1+p^2}|\,\dot{p}}{\int,\dot{p}\sqrt{1+p^2}|+C}, = a\int\frac{\dot{p}\sqrt{1+p^2}}{\int,\dot{p}\sqrt{1+p^2}|+C}.$$

The proceſs therefore of deſcribing the trajectory is, 1*ſt*. To find q in terms of p by the area of the curve whoſe abſciſſa is p and the ordinate is $\sqrt{1+p^2}$.

2*d*, We get x by the area of another curve whoſe abſciſſa is p, and the ordinate is $\frac{1}{q}$.

3*d*, We get y by the area of a third curve whoſe abſciſſa is p, and the ordinate is $\frac{p}{q}$

76 To compute the magnitude of the ordinate and abſciſſa.

The problem of the trajectory is therefore completely ſolved, becauſe we have determined the ordinate, abſciſſa, and arch of the curve for any given poſition of its tangent. It now only remains to compute the magnitudes of theſe ordinates and abſciſſæ, or to draw them by a geometrical conſtruction. But in this conſiſts the difficulty. The areas of theſe curves, which expreſs the lengths of x and y, can neither be computed nor exhibited geometrically, by any accurate method *yet* diſcovered, and we muſt content ourſelves with approximations. Theſe render the deſcription of the trajectory exceedingly difficult and tedious, ſo that little advantage has as yet been derived from the knowledge we have got of its properties. It will however greatly aſſiſt our conception of the ſubject to proceed ſome length in this conſtruction; for it muſt be acknowledged that very few diſtinct notions accompany a mere algebraic operation, eſpecially if in any degree complicated, which we confeſs is the caſe in the preſent queſtion.

Plate CCCCXVIII.

Let BmNR (fig. 8.) be an equilateral hyperbola, of which B is the vertex, BA the ſemitranſverſe axis, which we ſhall aſſume for the unity of length. Let AV be the ſemiconjugate axis = BA, = unity, and AS the aſſymptote, biſecting the right angle BAV. Let PN, $p\,n$ be two ordinates to the conjugate axis, exceedingly near to each other. Join BP, AN, and draw Bβ, Nν perpendicular to the aſſymptote, and BC parallel to AP. It is well known that BP is equal to NP. Therefore $PN^2 = BA^2 + AP^2$. Now ſince BA = 1, if we make AP = p of our formulæ, PN is $\sqrt{1+p^2}$, and Pp is = $\dot{p}$, and the area BAPNB = $\int,\dot{p}\sqrt{1+p^2}|$: That is to ſay, the number $\int,\dot{p}\sqrt{1+p^2}$ (for it is a number) has the ſame proportion to unity of number that the area BAPNB has to BCVA, the unit of ſurface. This area conſiſts of two parts, the triangle APN, and the hyperbolic ſector ABN. APN = $\frac{1}{2}$ AP × PN, = $\frac{1}{2}p\sqrt{1+p^2}$, and the hyperbolic ſector ABN = BNνβ, which is equivalent to the hyperbolic logarithm of the number repreſented by Aν when Aβ is unity. Therefore it is equal to $\frac{1}{2}$ the logarithm of $p+\sqrt{1+p^2}$. Hence we ſee by the bye that $\underline{\int,\dot{p}\sqrt{1+p^2}} = \frac{1}{2}p\sqrt{1+p^2} + \frac{1}{2}$ hyperbolic logarithm $p+\sqrt{1+p^2}$.

Now let AMD be another curve, ſuch that its ordinates Vm, PD, &c. may be proportional to the areas ABmV, ABNP, and may have the ſame proportion to AB, the unity of length, which theſe areas have to ABCV, the unity of ſurface. Then VM : VC = VmBA : VCBA and PD : Pδ = PNBA : VCBA, &c. Theſe ordinates will now repreſent $\int,\dot{p}\sqrt{1+p^2}$ with reference to a linear unit, as the areas to the hyperbola repreſented it in reference to a ſuperficial unit.

Again, in every ordinate make PD : Pδ = Pδ : PO, and thus we obtain a reciprocal to PD or to $\int,\dot{p}\sqrt{1+p^2}$, or equivalent to $\int,\frac{1}{\dot{p}\sqrt{.+p^2}}$. This will evidently be $\frac{\dot{x}}{a\dot{p}}$, and PO op will be $\frac{\dot{x}}{a}$, and the area contained between the lines AF, AW, and the curve GEOH, and cut off by the ordinate PO, will repreſent $\frac{x}{a}$.

Laſtly, make PO : PQ = AV : AP, = 1 : p; and then PQqp will repreſent $\frac{\dot{y}}{a}$, and the area ALEQP will repreſent $\frac{y}{a}$.

But we muſt here obſerve, that the fluents expreſſed by theſe different areas require what is called the *correction* to accommodate them to the circumſtances of the caſe. It is not indifferent from what ordinate we begin to reckon the areas. This depends on the initial direction of the projectile, and that point of the abſciſſa AP muſt be taken for the commencement of all the areas which gives a value of p ſuited to the initial direction. Thus, if the projection has been made from A (fig. 7.) at an elevation of 45°, the ratio of the fluxions $\dot{x}$ and $\dot{y}$ is that of equality; and therefore the point E of fig. 8. where the two curves interſect and have a common ordinate, evidently correſponds to this condition. The ordinate EV paſſes through V, ſo that AV or p = AB, = 1, = tangent 45°, as the caſe requires. The values of x and of y correſponding to any other point of the trajectory, ſuch as that which has AP for the tangent of the angle which it makes with the horizon, are now to be had by computing the areas VEOP, VEQP.

Plate. CCCCXVII.

Plate. CCCCXVIII.

Another curve might have been added, of which the ordinates would exhibit the fluxions of the arch of the trajectory $\dot{z} = \frac{a\dot{p}\sqrt{1+p^2}}{\int,\dot{p}\sqrt{1+p^2}|+C}$ and of which the area would exhibit the arch itſelf. And this would have been very eaſy, for it is $\dot{z} = a\frac{\dot{p}\sqrt{1+p^2}}{\int,\dot{p}\sqrt{1+p^2}|+C}$, which is evidently the fluxion of the hyperbolic logarithm of $\int,\dot{p}\sqrt{1+p^2}|$. But it is needleſs, ſince $\dot{z} = \dot{x}\sqrt{1+p^2}$, and we have already got $\dot{x}$. It is only increaſing PO in the ratio of BA to BP.

77 Conſequences of knowing the form of the trajectory.

And thus we have brought the inveſtigation of this problem a conſiderable length, having aſcertained the *form* of the trajectory. This is ſurely done when the ratio of the arch, abſciſs, and ordinate, and the poſition of its tangent, is determined in every point. But it is ſtill very far from a ſolution, and much remains to be done before we can make any practical application of it. The only general conſequence that we can deduce from the premiſes

Fig. 1.

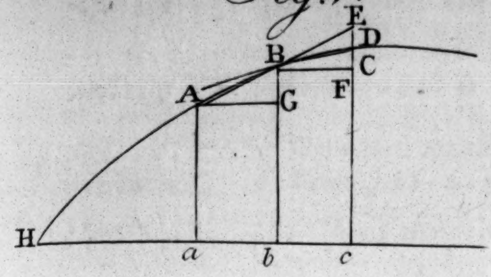

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Fig. 2.

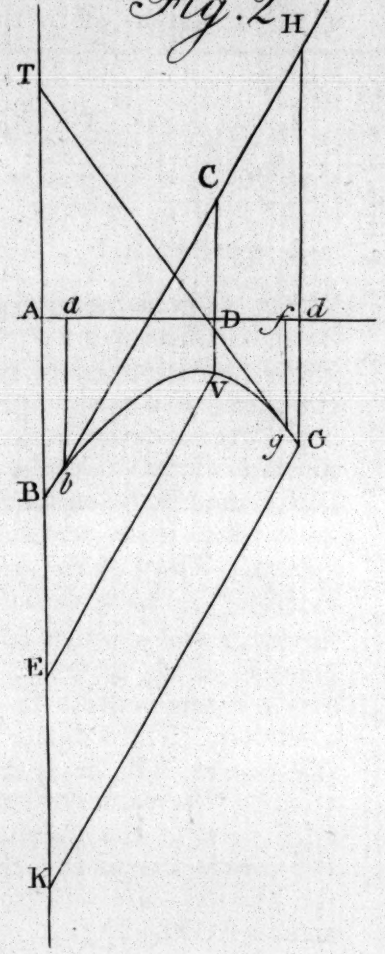
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Fig. 3

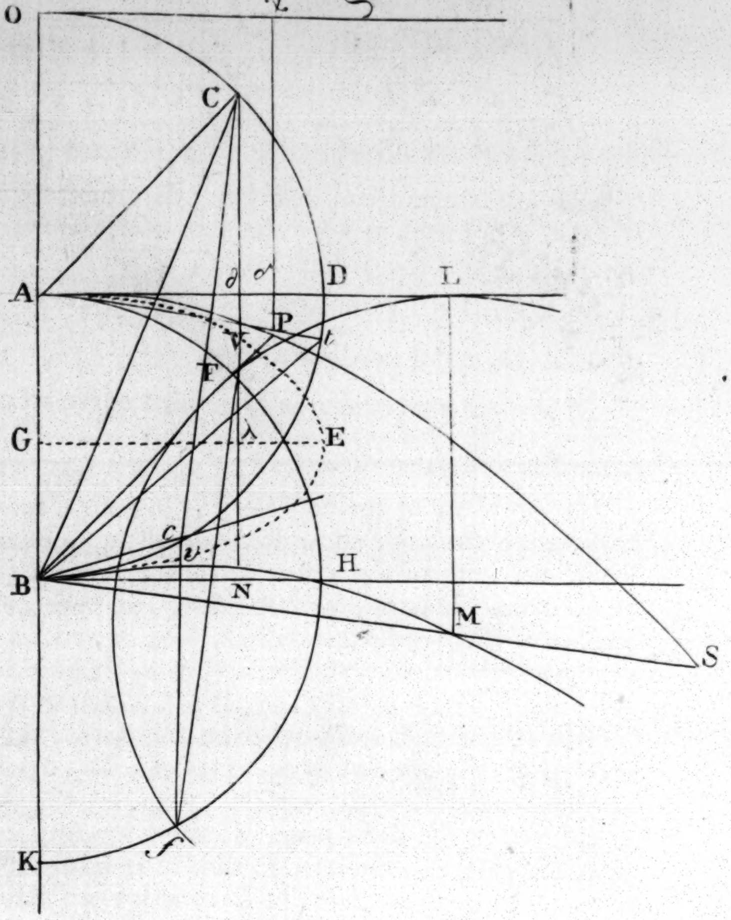
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Fig. 4.

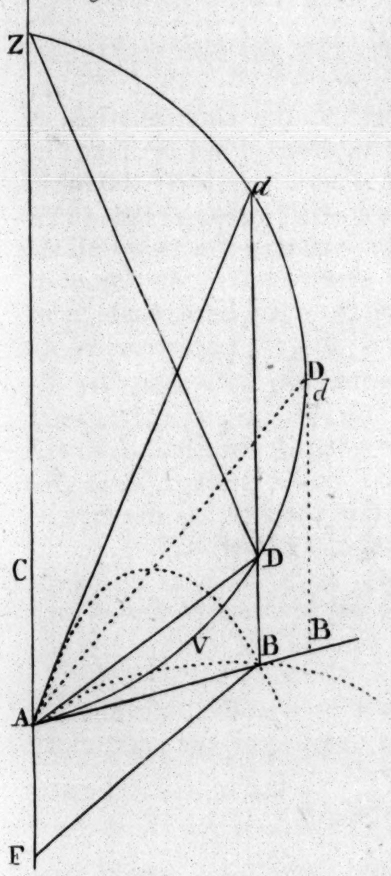
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Fig. 5 { called by mistake in the print 6 see 552p.

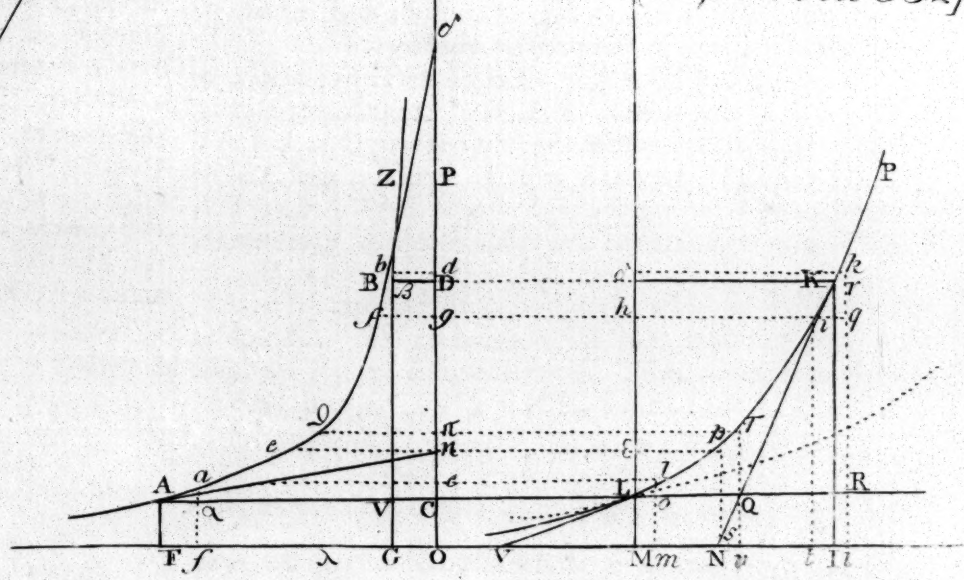
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Fig. 6.

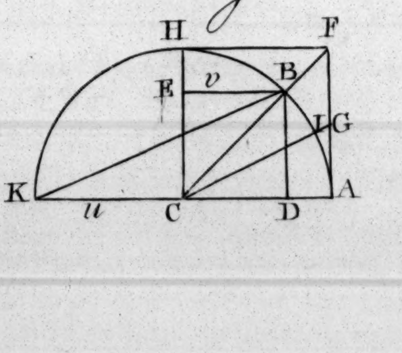
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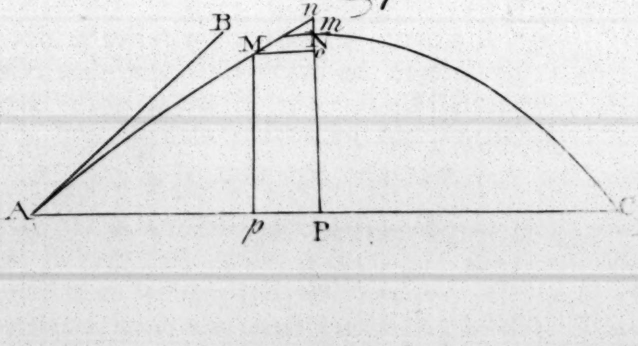
Fig. 7.



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ſts is, that in every caſe where the reſiſtance in any point bears the ſame proportion to the force of gravity, the trajectory will be ſimilar. Therefore two balls, of the ſame denſity, projected in the ſame direction, will deſcribe ſimilar trajectories if the velocities are in the ſubduplicate ratio of the diameters. This we ſhall find to be of conſiderable practical importance. But let us now proceed to determine the velocity in the different points of the trajectory, and the times of deſcribing its ſeveral portions.

78 To determine the velocity in different points.

Recollect, therefore, that $v^2 = \frac{-g\dot{z}^2}{\ddot{y}}$ and that $\dot{z}^2 = \dot{x}^2\,\overline{1+p^2}$ and $\ddot{y} = \dot{x}\dot{p}$. This gives $v^2 = \frac{-g\dot{x}\,\overline{1+p^2}}{\dot{p}}$. But $\dot{p} = q\dot{x}$. Therefore $v^2 = \frac{-g \times \overline{1+p^2}}{q}, = \frac{-ag\,\overline{1+p^2}}{\int,\dot{p}\sqrt{1+p^2}+C}$, and $v = \sqrt{\frac{-g\,\overline{1+p^2}}{q}}, = \frac{\sqrt{a}\sqrt{-g}\sqrt{1+p^2}}{\sqrt{\int\dot{p}\sqrt{1+p^2}|+C}}$.

Alſo $\dot{t}$ was found $= \frac{\dot{z}}{v}, = \frac{\dot{x}\sqrt{1+p^2}}{v}, = \frac{\dot{p}\sqrt{1+p^2}}{qv}$. If we now ſubſtitute for v its value juſt found, we obtain $\dot{t} = \frac{\dot{p}}{\sqrt{-gq}}$, and $t = \int\frac{\dot{p}}{\sqrt{-gq}}, = \int\frac{\dot{p}\sqrt{a}}{\sqrt{-g\int\dot{p}\sqrt{1+p^2}|+C}}, = \frac{\sqrt{a}}{\sqrt{-g}} \times \int\frac{\dot{p}}{\sqrt{\int\dot{p}\sqrt{1+p^2}|+C}}$.

79 Difficulty of accommodating the formulæ to particular caſes.

The greateſt difficulty ſtill remains, viz. the accommodating theſe formulæ, which appear abundantly ſimple, to the particular caſes. It would appear at firſt ſight that all trajectories are ſimilar; ſince the ratio of the fluxions of the ordinate and abſciſſa correſponding to any particular angle of inclination to the horizon ſeems the ſame in them all: but a due attention to what has been hitherto ſaid on the ſubject will ſhow us that we have as yet only been able to aſcertain the velocity in the point of the trajectory, which has a certain inclination to the horizon, indicated by the quantity p, and the time (reckoned from ſome aſſigned beginning) when the projectile is in that point.

To obtain abſolute meaſures of theſe quantities, the term of commencement muſt be fixed upon. This will be expreſſed by the conſtant quantity C, which is aſſumed for completing the fluent of $\dot{p}\sqrt{1+p^2}$, which is the baſis of the whole conſtruction. We there found $q = \frac{\int,\dot{p}\sqrt{1+p^2}}{a}$. This fluent is in general $q = \frac{C+\int,\dot{p}\sqrt{1+p^2}}{a}$, and the conſtant quantity C is to be accommodated to ſome circumſtances of the caſe.

80 Euler's method the ſimpleſt.

Different authors have ſelected different circumſtances, Euler, in his Commentary on Robins, and in a diſſertation in the Memoirs of the Academy of Berlin publiſhed in 1753, takes the vertex of the curve for the beginning of his abſciſſa and ordinate. This is the ſimpleſt method of any, for C muſt then be ſo choſen that the whole fluent may vaniſh when $p = 0$, which is the caſe in the vertex of the curve, where the tangent is parallel to the horizon. We ſhall adopt this method.

Plate CCXVIII.

Therefore, let AP (fig. 9.) $= x$, PM $= y$. AM $= z$. Put the quantity C which is introduced into the fluent equal to $\frac{n}{a}$. It is plain that n muſt be a number; for it muſt be homologous with $\dot{p}\sqrt{1+p^2}$, which is a number. For brevity's ſake let us expreſs the fluent of $\dot{p}\sqrt{1+p^2}$ by the ſingle letter P; and thus we ſhall have $x = a \times \int\frac{\dot{p}}{n+P}$, $y = a \times \int\frac{p\dot{p}}{n+P}$, $z = a \times \int\frac{\dot{p}\sqrt{1+p^2}}{n+P}$. And $v^2 = \frac{-ag\,(1+p^2)}{n+P}$. Now the height h neceſſary for communicating any velocity v is $\frac{v^2}{2g} = \frac{-ag\,(1+p^2)}{2g\,(n+P)}, = \frac{-\frac{1}{2}a\,(1+p^2)}{n+P}$. And laſtly, $t = \frac{\sqrt{a}}{\sqrt{g}}\int\frac{\dot{p}}{\sqrt{n+P}}$.

Theſe fluents, being all taken ſo as to vaniſh at the vertex, where the computation commences, and where p is $= 0$ (the tangent being parallel to the horizon), we obtain in this caſe $h = \frac{\frac{1}{2}a}{n}, = \frac{a}{2n}$, and $n = \frac{a}{2h}$.

Hence we ſee that the circumſtance which modifies all the curves, diſtinguiſhing them from each other, is the velocity (or rather its ſquare) in the higheſt point of the curve. For h being determined for any body whoſe terminal velocity is u, n is alſo determined; and this is the modifying circumſtance. Conſidering it geometrically, it is the area which muſt be cut off from the area DMAP of fig. 8. in order to determine the ordinates of the other curves.

We muſt farther remark, that the values now given relate only to that part of the area where the body is deſcending from the vertex. This is evident; for in order that y may increaſe as we recede from the vertex, its fluxion muſt be taken in the oppoſite ſenſe to what it was in our inveſtigation. *There* we ſuppoſed y to increaſe as the body aſcended, and then to diminiſh during the deſcent; and therefore the fluxion of y was firſt poſitive and then negative.

The ſame equations, however, will ſerve for the aſcending branch CNA of the curve, only changing the ſign of P; for if we conſider y as decreaſing during the aſcent, we muſt conſider q as expreſſing $\frac{-\dot{p}}{\dot{x}}$, and therefore P, or $\int\dot{p}\sqrt{1+p^2}$, which is $= \frac{q}{a}$, muſt be taken negatively. Therefore, in the aſcending branch, we have AQ or x (increaſing as we recede from A) $= a \times \int\frac{\dot{p}}{n-P}$, QN or $y = a \times \int\frac{p\dot{p}}{n-P}$, AN or $z = a \times \int\frac{\dot{p}\sqrt{1+p^2}}{n-P}$, $t = \frac{\sqrt{a}}{\sqrt{g}} \times \int\frac{\dot{p}}{\sqrt{1-P}}$, and the height producing the velocity at N $= \frac{\frac{1}{2}a\,(1+p^2)}{n-P}$.

81 Remarkable property of the curve or trajectory.

Hence we learn by the bye, that in no part of the aſcending branch can the inclination of the tangent be ſuch that P ſhall be greater than n; and that if we ſuppoſe P equal to n in any point of the curve, the velocity in that point will be infinite. That is to ſay, there is a certain aſſignable elevation of the tangent which cannot be exceeded in a curve which has this velocity in the vertex. The beſt way for forming a conception of this circumſtance in the nature of the curve, is to invert the motion, and ſuppoſe an accelerating force equal and oppoſite to the reſiſtance, to act on the body in conjunction with gravity. It muſt deſcribe the ſame curve, and this branch ANC muſt have an aſſymptote LO, which has this limiting poſition of the tangent. For, as the body deſcends in this curve, its velocity increaſes to infinity by the joint action of gravity and this *accelerating* force, and yet the tangent never approaches ſo near the perpendicular poſition as to make $P = n$. This remarkable property of the curve was known to Newton, as appears by his approximations, which all lead him to curves of a hyperbolic form, having one aſſymptote inclined to the horizon. Indeed it is pretty obvious: For the reſiſtance increaſing faſter than the velocity, there is no velocity of projection ſo great but that the curve will come to deviate ſo from the tangent, that in a finite time it will become parallel to the horizon. Were the reſiſtance proportional to the velocity, then an infinite velocity would produce a rectilineal motion, or rather a deflection from it leſs than any that can be aſſigned.

82
On what its form and magnitude depends.

We now ſee that the particular form and magnitude of this trajectory depends on two circumſtances, a and n. a affects chiefly the magnitude. Another circumſtance might indeed be taken in, viz. the diminution of the accelerating force of gravity by the ſtatical effect of the air's gravity. But, as we have already obſerved, this is too trifling to be attended to in military projectiles.

$\frac{\dot{y}}{\dot{x}}$ was made equal to $\dot{p}$. Therefore the radius of curvature, determined by the ordinary methods, is $\frac{\dot{x}(1+p^2)(\sqrt{1+p^2})}{\dot{p}}$ *, and, becauſe $\frac{\dot{x}}{\dot{p}}$ is $= \frac{a}{n+P}$ for the deſcending branch of the curve, the radius of curvature at M is $\frac{a \times \overline{1+p^2} \times \sqrt{1+p^2}}{n+P}$, and, in the aſcending branch at N, it is $\frac{a \times \overline{1+p^2} \times \sqrt{1+p^2}}{n-P}$. On both ſides therefore, when the velocity is infinitely great, and P by this means ſuppoſed to equal or exceed n, the radius of curvature is alſo infinitely great. We alſo ſee that the two branches are unlike each other, and that when p is the ſame in both, that is, when the tangent is equally inclined to the horizon, the radius of curvature, the ordinate, the abſciſs, and the arch, are all greater in the aſcending branch. This is pretty obvious. For as the reſiſtance acts entirely in diminiſhing the velocity, and does not affect the deflection occaſioned by gravity, it muſt allow gravity to incurvate the path ſo much the more (with the ſame inclination of its line of action) as the velocity is more diminiſhed. The curvature, therefore, in thoſe points which have the ſame inclination of the tangent, is greateſt in the deſcending branch, and the motion is ſwifteſt in the aſcending branch. It is otherwiſe in a void, where both ſides are alike. Here u becomes infinite, or there is no terminal velocity; and n alſo becomes infinite, being $= \frac{a}{2b}$.

It is therefore in the quantity P, or $\int \dot{p}\sqrt{1+p^2}$, that the difference between the trajectory in a void and in a reſiſting medium conſiſts; it is this quantity which expreſſes the accumulated change of the ratio of the increments of the ordinate and abſciſs. In vacuo the ſecond increment of the ordinate is conſtant when the firſt increment of the abſciſſa is ſo, and the whole increment of the ordinate is as $1+p$. And this difference is ſo much the greater as P is greater in reſpect of n. P is nothing at the vertex, and increaſes along with the angle MTP; and when this is a right angle, P is infinite. The trajectory in a reſiſting medium will come therefore to deviate infinitely from a parabola, and may even deviate farther from it than the parabola deviates from a ſtraight line. That is, the diſtance of the body in a given moment from that point of its parabolic path where it would have been in a void, is greater than the diſtance between that point of the parabola from the point of the ſtraight line where it would have been, independent of the action of gravity. This muſt happen whenever the reſiſtance is greater than the weight of the body, which is generally the caſe in the beginning of the trajectory in military projectiles; and this (were it now neceſſary) is enough to ſhow the inutility of the parabolic theory.

83
Several properties of it aſcertained.

Although we have no method of deſcribing this trajectory, which would be received by the ancient geometers, we may aſcertain ſeveral properties of it, which will aſſiſt us in the ſolution of the problem. In particular, we can aſſign the abſolute length of any part of it by means of the logiſtic curve. For becauſe $P = \int \dot{p}\sqrt{1+p^2}$, we have $\dot{p}\sqrt{1+p^2} = \dot{P}$, and therefore z, which was $= a \times \int \frac{\dot{p}\sqrt{1+p^2}}{\int \dot{p}\sqrt{1+p^2}|} + C$, or $= a \times \int \frac{\dot{P}}{n+P}$, may be expreſſed by logarithms; or $z = a \times$ hyp. log. of $\frac{n+P}{n}$, ſince at the vertex A, where z muſt be $= 0$, P is alſo $= 0$.

Being able, in this way, to aſcertain the length AM of the curve (counted from the vertex), correſponding to any inclination p of the tangent at its extremity M, we can aſcertain the length of any portion of it, ſuch as M m, by firſt finding the length of the part A m, and then of the part AM. This we do more expeditiouſly thus: Let p expreſs the poſition of the tangent in M, and q its poſition at m; then $AM = a \times \log. \frac{n+P}{n}$ and $Am = a \times \log. \frac{n+Q}{n}$, and therefore M m is $= a \times \log. \frac{n+Q}{n+P}$. Thus we can find the values of a great number of ſmall portions, and the inclination of the tangents at their extremities. Then to each of theſe portions we can aſſign its proportion of the abciſſa and ordinate, without having recourſe to the values of x and y. For the portion of abſciſs correſponding to the arch M m, whoſe middle point is inclined to the horizon in the angle b, will be M m × coſine b, and the correſponding portion of the ordinate will be M m × ſin. b. Then we obtain the velocity in each part of the curve by the equation $h = \frac{\frac{1}{2} a \times \overline{1+p^2}}{n+p}$; or, more directly the velocity v at M will be $= \sqrt{ag}\,\frac{\sqrt{1+p^2}}{\sqrt{n+P}}$. Laſtly, divide the length of the little arch by this, and the quotient will be the time of deſcribing M m very nearly. Add all theſe together, and we obtain the whole time of deſcribing the arch AM, but a little too great, becauſe the motion in the ſmall arch is not perfectly uniform. The error, however, may be as ſmall as we pleaſe, becauſe we may make the arch as ſmall as we pleaſe; and for greater accuracy, it will be proper to take the p by which we compute the velocity, a medium between the p for the beginning and that for the end of the arch.

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* Simpſon's Fluxions, § 68, &c.

84 Euler's method preferred.

This is the method followed by Euler, who was one of the moſt expert analyſts, if not the very firſt, in Europe. It is not the moſt elegant, and the methods of ſome other authors, who approximate directly to the areas of the curves which determine the values of x and y, have a more ſcientific appearance; but they are not ultimately very different: For, in ſome methods, theſe areas are taken piecemeal, as Euler takes the arch; and by the methods of others, who give the value of the areas by Newton's method of deſcribing a curve of the parabolic kind through any number of given points, the ordinates of theſe curves, which expreſs $\dot{x}$ and $\dot{y}$, muſt be taken ſingly, which amounts to the ſame thing, with the great diſadvantage of a much more complicated calculus, as any one may ſee by comparing the expreſſions of $\dot{x}$ and $\dot{y}$ with the expreſſion of $\dot{z}$. As to thoſe methods which approximate directly to the areas or values of x and y by an infinite ſeries, they all, without exception, involve us in moſt complicated expreſſions, with coefficients of ſines and tangents, and ambiguous ſigns, and engage us in a calculation almoſt endleſs. And we know of no ſeries which converges faſt enough to give us tolerable accuracy, without ſuch a number of terms as is ſufficient to deter any perſon from the attempt. The calculation of the arches is very moderate, ſo that a perſon tolerably verſant in arithmetical operations may compute an arch with its velocity and time in about five minutes. We have therefore no heſitation in preferring this method of Euler's to all that we have ſeen, and therefore proceed to determine ſome other circumſtances which render its application more general.

85 Its application made more general.

If there were no reſiſtance, the ſmalleſt velocity would be at the vertex of the curve, and it would immediately increaſe by the action of gravity conſpiring (in however ſmall degree) with the motion of the body. But in a reſiſting medium, the velocity at the vertex is diminiſhed by a quantity to which the acceleration of gravity in that point bears no aſſignable proportion. It is therefore diminiſhed, upon the whole, and the point of ſmalleſt velocity is a little way beyond the vertex. For the ſame reaſons, the greateſt curvature is a little way beyond the vertex. It is not very material for our preſent purpoſe to aſcertain the exact poſitions of thoſe points.

The velocity in the deſcending branch augments continually: but it cannot exceed a certain limit, if the velocity at the vertex has been leſs than the terminal velocity; for when the curve is infinite, p is alſo infinite, and $h = \frac{\frac{1}{2} ap^2}{P}$, becauſe n in this caſe is nothing in reſpect of P, which is infinite; and becauſe p is infinite, the number hyp. log. $\overline{p + \sqrt{1+p^2}}$, though infinite, vaniſhes in compariſon with $p \times \sqrt{1+p^2}$; ſo that in this caſe $P = \frac{1}{2}p^2$, and $h = a$, and $v =$ the terminal velocity.

If, on the other hand, the velocity at the vertex has been greater than the terminal velocity, it will diminiſh continually, and when the curve has become infinite, v will be equal to the terminal velocity.

In either caſe we ſee that the curve on this ſide will have a perpendicular aſſymptote. It would require a long and pretty intricate analyſis to determine the place of this aſſymptote, and it is not material for our preſent purpoſe. The place and poſition of the other aſſymptote LO is of the greateſt moment. It evidently diſtinguiſhes the kind of trajectory from any other. Its poſition depends on this circumſtance, that if p marks the poſition of the tangent, $n-P$, which is the denominator of the fractions expreſſing the ſquare of the velocity, muſt be equal to nothing, becauſe the velocity is infinite: therefore, in this place, $P = n$, or $n = \frac{1}{2}p\sqrt{1+p^2} + \frac{1}{2}\text{log.}\,\overline{p+\sqrt{1+p^2}}$. In order, therefore, to find the point L, where the aſſymptote LO cuts the horizontal line AL, put $P = n$, then will $AL = x - \frac{y\dot{x}}{\dot{y}}, = a \times \left(\int\frac{\dot{p}}{n-P} - \frac{1}{p}\int\frac{p\dot{p}}{n-P}\right)$.

Through the whole of this article $\int$ means fluent.

It is evident that the logarithms uſed in theſe expreſſions are the natural or hyperbolic. But the operations may be performed by the common tables by making the value of the arch M m of the curve $= \frac{a}{M} \times \text{log.}\,\frac{n+Q}{n+P}$ &c. where M means the ſubtangent of the common logarithms, or 0,43429; alſo the time of deſcribing this arch will be expeditiouſly had by taking a medium μ between the values of $\frac{\sqrt{1+p^2}}{\sqrt{n+P}}$ and $\frac{\sqrt{1+q^2}}{\sqrt{n+Q}}$, and making the time $= \frac{\sqrt{a}}{M\mu\sqrt{g}} \times \text{log.}\,\frac{n+Q}{n+P}$.

86 Mode of applying this proceſs in practice.

Such then is the proceſs by which the form and magnitude of the trajectory, and the motion in it, may be determined. But it does not yet appear how this is to be applied to any queſtion in practical artillery. In this proceſs we have only learned how to compute the motion from the vertex in the deſcending branch till the ball has acquired a particular direction, and the motion to the vertex from a point of the aſcending branch where the ball has another direction, and all this depending on the greateſt velocity which the body can acquire by falling, and the velocity which it has in the vertex of the curve. But the uſual queſtion is, "What will be the motion of the ball projected in a certain direction with a certain velocity?"

The mode of application is this: Suppoſe a trajectory computed for a particular terminal velocity, produced by the fall a, and for a particular velocity at the vertex, which will be characterized by n, and that the velocity at that point of the aſcending branch where the inclination of the tangent is 30° is 900 feet *per* ſecond. Then, we are certain that if a ball, whoſe terminal velocity is that produced by the fall a, be projected with the velocity of 900 feet per ſecond, and an elevation of 30°, it will deſcribe this very trajectory, and the velocity and time correſponding to every point will be ſuch as is here determined.

Now this trajectory will, in reſpect to form, anſwer an infinity of caſes: for its characteriſtic is the proportion of the velocity in the vertex to the terminal velocity. When this proportion is the ſame, the number n will be the ſame. If therefore we compute the trajectories for a ſufficient variety of theſe proportions, we ſhall find a trajectory that will nearly correſpond to any caſe that can be propoſed; and an approximation ſufficiently exact will be had by taking a proportional medium between the two trajectories which come neareſt to the caſe propoſed.

87 Computed tables or trajectories.

Accordingly, a ſet of tables or trajectories have been computed by the Engliſh tranſlator of Euler's Commentary on Robins's Gunnery. They are in number 18, diſtinguiſhed by the poſition of the aſſymptote of the aſcending branch. This is given for 5°, 10°, 15°, &c. to 85°, and the whole trajectory is computed as far as it can ever be ſuppoſed to extend in practice. The following table gives the value of the number n correſponding to each poſition of the aſſymptote.

OLB	n	OLB	n
0	0,00000	45	1,14779
5	0,08760	50	1,43236
10	0,17724	55	1,82207
15	0,27712	60	2,39033
20	0,37185	65	3,29040
25	0,48269	70	4,88425
30	0,60799	75	8,22357
35	0,75382	80	17,54793
40	0,92914	85	67,12291

Since the path of a projectile is much leſs incurvated, and more rapid in the aſcending than in the deſcending branch, and the difference is ſo much the more remarkable in great velocities; it muſt follow, that the range on a horizontal or inclined plane depends moſt on the aſcending branch: therefore the greateſt range will not be made with that elevation which biſects the angle of poſition, but with a lower elevation; and the deviation from the biſecting elevation will be greater as the initial velocities are greater. It is very difficult to frame an exact rule for determining the elevation which gives the greateſt range. We have ſubjoined a little table which gives the proper elevations (nearly) correſponding to the different initial velocities.

It was computed by the following approximation, which will be found the ſame with the ſeries uſed by Newton in his Approximations.

Let e be the angle of elevation, a the height producing the terminal velocity, b the height producing the initial velocity, and c the number whoſe hyperbolic logarithm is 1 (*i. e.* the number 2,718) Then,

$$y = x \times \left(\text{tan. } e + \frac{a}{2\,b.\,\text{coſ. } e}\right) - \frac{a^2}{2b}\left(\text{C}^{\frac{x}{a.\text{coſ.}e.}} - 1\right),$$

&c. Make $y = v$, and take the maximum by varying e, we obtain $\text{Sin.}^{2}\,\overline{e + \frac{a.\ \text{ſin.}\ e.}{2b}} =$ hyperbol. log. $\left(1 + \frac{2b}{a\ \text{ſine}\ e}\right)$, which gives us the angle e.

The numbers in the firſt column, multiplied by the terminal velocity of the projectile, give us the initial velocity; and the numbers in the laſt column, being multiplied by the height producing the terminal velocity, and by 2,3026, give us the greateſt ranges. The middle column contains the elevation. The table is not computed with ſcrupulous exactneſs, the queſtion not requiring it. It may however be depended on within one part of 2000

To make uſe of this table, divide the initial velocity by the terminal velocity u, and look for the quotient in the firſt column. Oppoſite to this will be found the elevation giving the greateſt range; and the number in the laſt column being multiplied by 2,3026 × a (the height producing the terminal velocity) will give the range.

TABLE of Elevations giving the greateſt Range.

Initial vel. / u,	Elevation.	Range. / $2,3026a$,
0,6909	43°.40′	0,1751
0,7820	43 .20	0,2169
0,8645	42 .50	0,2548
1,3817	41 .40	0,4999
1,5641	40 .20	0,5789
1,7291	40 .10	0,6551
2,0726	39 .50	0,7877
2,3461	37 .20	0,8967
2,5936	35 .50	0,9752
2,7635	35 .—	1,0319
3,1281	34 .40	1,1411
3,4544	34 .20	1,2298
3,4581	34 .20	1,2277
3,9101	33 .50	1,3371
4,1452	33 .30	1,3901
4,3227	33 .30	1,4274
4,6921	31 .50	1,5050
4,8361	31 .50	1,5341

88 Advantage to be derived from the ſolution of the problem.

Such is the ſolution which the preſent ſtate of our mathematical knowledge enables us to give of this celebrated problem. It is exact in its principle, and the application of it is by no means difficult, or even operoſe. But let us ſee what advantage we are likely to derive from it.

In the firſt place, it is very limited in its application. There are few circumſtances of general coincidence, and almoſt every caſe requires an appropriated calculus. Perhaps the only general rules are the two following:

1. Balls of equal denſity, projected with the ſame elevation, and with velocities which are as the ſquare-roots of their diameters, will deſcribe ſimilar curves.— This is evident, becauſe, in this caſe, the reſiſtance will be in the ratio of their quantities of motion. Therefore

all the homologous lines of the motion will be in the proportion of the diameters.

2. If the initial velocities of balls projected with the ſame elevation are in the inverſe ſubduplicate ratio of the whole reſiſtances, the ranges, and all the homologous lines of their track, will be inverſely as thoſe reſiſtances.

Theſe theorems are of conſiderable uſe: for by means of a proper ſeries of experiments on one ball projected with different elevations and velocities, tables may be conſtructed which will aſcertain the motions of an infinity of others.

89 Shown from various conſiderations to be very little.

But when we take a retroſpective view of what we have done, and conſider the conditions which were aſſumed in the ſolution of the problem, we ſhall find that much yet remains before it can be rendered of great practical uſe, or even ſatiſfy the curioſity of the man of ſcience. The reſiſtance is all along ſuppoſed to be in the duplicate ratio of the velocity; but even theory points out many cauſes of deviation from this law, ſuch as the preſſure and condenſation of the air, in the caſe of very ſwift motions; and Mr Robins's experiments are ſufficient to ſhow us that the deviations muſt be exceedingly great in ſuch caſes. Mr Euler and all ſubſequent writers have allowed that it may be three times greater, even in caſes which frequently occur; and Euler gives a rule for aſcertaining with tolerable accuracy what this increaſe and the whole reſiſtance may amount to. Let H be the height of a column of air whoſe weight is equivalent to the reſiſtance taken in the duplicate ratio of the velocity. The whole reſiſtance will be expreſſed by $H + \frac{H^2}{28845}$. This number 28845 is the height in feet of a column of air whoſe weight balances its elaſticity. We ſhall not at preſent call in queſtion his reaſons for aſſigning this preciſe addition. They are rather reaſons of arithmetical conveniency than of phyſical import. It is enough to obſerve, that if this meaſure of the reſiſtance is introduced into the proceſs of inveſtigation, it is totally changed; and it is not too much to ſay, that with this complication it requires the knowledge and addreſs of a Euler to make even a partial and very limited approximation to a ſolution.—Any law of the reſiſtance, therefore, which is more complicated than what Bernoulli has aſſumed, namely, that of a ſimple power of the velocity, is abandoned by all the mathematicians, as exceeding their abilities; and they have attempted to avoid the error ariſing from the aſſumption of the duplicate ratio of the velocity, either by ſuppoſing the reſiſtance throughout the whole trajectory to be greater than what it is in general, or they have divided the trajectory into different portions, and aſſigned different reſiſtances to each, which vary, through the whole of that portion, in the duplicate ratio of the velocities. By this kind of patchwork they make up a trajectory and motion which correſponds, in ſome tolerable degree, with what? With an accurate theory? No; but with a ſeries of experiments. For, in the firſt place, every theoretical computation that we make, proceeds on a ſuppoſed initial velocity; and this cannot be aſcertained with any thing approaching to preciſion, by any theory of the action of gunpowder that we are yet poſſeſſed of. In the next place, our theories of the reſiſting power of the air are entirely eſtabliſhed on the experiments on the flights of ſhot and ſhells, and are corrected and amended till they tally with the moſt approved experiments we can find.

We do not learn the ranges of a gun by theory, but the theory by the range of the gun. Now the variety and irregularity of all the experiments which are appealed to are ſo great, and the acknowledged difference between the reſiſtance to ſlow and ſwift motions is alſo ſo great, that there is hardly any ſuppoſition which can be made concerning the reſiſtance, that will not agree in its reſults with many of thoſe experiments. It appears from the experiments of Dr Hutton of Woolwich, in 1784, 1785, and 1786, that the ſhots frequently deviated to the right or left of their intended track 200, 300, and ſometimes 400 yards. This deviation was quite accidental and anomalous, and there can be no doubt but that the ſhot deviated from its intended and *ſuppoſed* elevation as much as it deviated from the intended vertical plane, and this without any opportunity of meaſuring or diſcovering the deviation. Now, when we have the whole range from one to three to chooſe among for our meaſure of reſiſtance, it is evident that the confirmations which have been drawn from the ranges of ſhot are but feeble arguments for the truth of any opinion. Mr Robins finds his meaſures fully confirmed by the experiments at Metz and at Minorca. Mr Muller finds the ſame. Yet Mr Robins's meaſure both of the initial velocity and of the reſiſtance are at leaſt treble of Mr Muller's; but by compenſation they give the ſame reſults. The Chevalier Borda, a very expert mathematician, has adduced the very ſame experiments in ſupport of his theory, in which he abides by the Newtonian meaſure of the reſiſtance, which is about $\frac{1}{3}$ of Mr Robins's, and about $\frac{2}{3}$ of Muller's.

90 Cauſes of its inutility.

What are we to conclude from all this? Simply this, that we have hardly any knowledge of the air's reſiſtance, and that even the ſolution given of this problem has not as yet greatly increaſed it. Our knowledge conſiſts only in thoſe experiments, and mathematicians are attempting to patch up ſome notion of the motion of a body in a reſiſting medium, which ſhall tally with them.

There is another eſſential defect in the conditions aſſumed in the ſolution. The denſity of the air is ſuppoſed uniform; whereas we are certain that it is leſs by one fifth or one ſixth towards the vertex of the curve, in many caſes which frequently occur, than it is at the beginning and end of the flight. This is another latitude given to authors in their aſſumptions of the air's reſiſtance. The Chevalier de Borda has, with conſiderable ingenuity, accommodated his inveſtigation to this circumſtance, by dividing the trajectory into portions, and, without much trouble, has made one equation anſwer them all. We are diſpoſed to think that his ſolution of the problem (in the Memoirs of the Academy of Paris for 1769) correſponds better with the phyſical circumſtances of the caſe than any other. But his proceſs is there delivered in too conciſe a manner to be intelligible to a perſon not perfectly familiar with all the reſources of modern analyſis. We therefore preferred John Bernoulli's, becauſe it is elementary and rigorous.

After all, the practical artilleriſt muſt rely chiefly on the records of experiments contained in the books of

91 Neceſſity attending to experiments.

practice at the academies, or thoſe made in a more public manner. Even a perfect theory of the air's reſiſtance can do him little ſervice, unleſs the force of gunpowder were uniform. This is far from being the caſe even in the ſame powder. A few hours of a damp day will make a greater difference than occurs in any theory; and, in ſervice, it is only by trial that every thing is performed. If the firſt ſhell falls very much ſhort of the mark, a little more powder is added; and, in cannonading, the correction is made by varying the elevation.

We hope to be forgiven by the eminent mathematicians for theſe obſervations on their theories. They by no means proceed from any diſreſpect for their labours. We are not ignorant of the almoſt inſuperable difficulty of the taſk, and we admire the ingenuity with which ſome of them have contrived to introduce into their analyſis reaſonable ſubſtitutions for thoſe terms which would render the equations intractable. But we muſt ſtill ſay, upon their own authority, that theſe are but ingenious gueſſes, and that experiment is the touchſtone by which they mould their ſubſtitutions; and when they have found a coincidence, they have no motive to make any alteration. Now, when we have ſuch a latitude for our meaſure of the air's reſiſtance, that we may take it of any value, from one to three, it is no wonder that compenſations of errors ſhould produce a coincidence; but where is the coincidence? The theoriſt *ſuppoſes* the ball to ſet out with a certain velocity, and his theory gives a certain range; and this range agrees with obſervation—but how? Who knows the velocity of the ball in the experiment? This is concluded from a theory incomparably more uncertain than that of the motion in a reſiſting medium.

The experiments of Mr Robins and Dr Hutton ſhow, in the moſt incontrovertible manner, that the reſiſtance to a motion exceeding 1100 feet in a ſecond, is almoſt *three times* greater than in the duplicate ratio to the reſiſtance to moderate velocities. Euler's tranſlator, in his compariſon of the author's trajectories with experiment, ſuppoſes it to be *no* greater. Yet the coincidence is very great. The ſame may be ſaid of the Chevalier de Borda's. Nay, the ſame may be ſaid of Mr Robins's own practical rules: for he makes his F, which correſponds to our *a*, almoſt double of what theſe authors do, and yet his rules are confirmed by practice. Our obſervations are therefore well founded.

92 The theory is ſtill of ſome uſe in practice,

But it muſt not be inferred from all this, that the phyſical theory is of no uſe to the practical artilleriſt. It plainly ſhows him the impropriety of giving the projectile an enormous velocity. This velocity is of no effect after 200 or 300 yards at fartheſt, becauſe it is ſo rapidly reduced by the prodigious reſiſtance of the air. Mr Robins has deduced ſeveral practical maxims of the greateſt importance from what we already know of this ſubject, and which could hardly have been even conjectured without this knowledge. See GUNNERY.

93 And may be brought to greater perfection.

And it muſt ſtill be acknowledged, that this branch of phyſical ſcience is highly intereſting to the philoſopher; nor ſhould we deſpair of carrying it to greater perfection. The defects ariſe almoſt entirely from our ignorance of the law of variation of the air's reſiſtance. Experiments may be contrived much more conducive to our information here than thoſe commonly reſorted to. The oblique flights of projectiles are, as we have ſeen, of very complicated inveſtigation, and ill fitted for inſtructing us; but numerous and well contrived experiments on the perpendicular aſcents are of great ſimplicity, being affected by nothing but the air's reſiſtance. To make them inſtructive, we think that the following plan might be purſued. Let a ſet of experiments be premiſed for aſcertaining the initial velocities. Then let ſhells be diſcharged perpendicularly with great varieties of denſity and velocity, and let nothing be attended to but the height and the time; even a conſiderable deviation from the perpendicular will not affect either of theſe circumſtances, and the effect of this circumſtance can eaſily be computed. The height can be aſcertained with ſufficient preciſion for very valuable information by their light or ſmoke. It is evident that theſe experiments will give *direct* information of the air's retarding force; and every experiment gives us two meaſures, viz. the aſcent and deſcent: and the compariſon of the times of aſcent or deſcent, combined with the obſerved height in one experiment made with a great initial velocity, will give us more information concerning the air's reſiſtance than 50 ranges. If we ſhould ſuppoſe the reſiſtance as the ſquare of the velocity, this compariſon will give in each experiment an exact determination of the initial and final velocities, which no other method can give us. Theſe, with experiments on the *time* of horizontal flights, with known initial velocities, will give us more inſtruction on this head than any thing that has yet been done; and till ſomething of this kind is carefully done, we preſume to ſay that the motion of bodies in a reſiſting medium will remain in the hands of the mathematicians as a matter of curious ſpeculation. In the mean time, the rules which Mr Robins has delivered in his Gunnery are very ſimple and eaſy in their uſe, and ſeem to come as near the truth as any we have met with. He has not informed us upon what principles they are founded, and we are diſpoſed to think that they are rather empirical than ſcientific. But we profeſs great deference for his abilities and penetration, and doubt not but that he had framed them by means of as ſcientific a diſcuſſion as his knowledge of this new and difficult ſubject enabled him to give it.

95 Tables calculated on the preceding principles.

We ſhall conclude this article, by giving two or three tables, computed from the principles eſtabliſhed above, and which ſerve to bring into one point of view the chief circumſtances of the motion in a reſiſting medium. Although the reſult of much calculation, as any perſon who conſiders the ſubject will readily ſee, they muſt not be conſidered as offering any very accurate reſults; or that, in compariſon with one or two experiments, the differences ſhall not be conſiderable. Let any perſon peruſe the publiſhed regiſters of experiments which have been made with every attention, and he will ſee ſuch enormous irregularities, that all expectations of perfect agreement with them muſt ceaſe. In the experiments at Woolwich in 1735, which were continued for ſeveral days, not only do the experiments of one day differ among themſelves, but the mean of all the experiments of one day differs from the mean of all the experiments of another no leſs than one fourth of the whole. The experiments in which the greateſt regularity may be expected, are thoſe made with great elevations. When the elevation is ſmall, the range is more affected by a change of velocity, and ſtill more by any deviation from the ſuppoſed or intended direction of the ſhot.

The firſt table ſhows the diſtance in yards to which a ball projected with the velocity 1600 will go, while its velocity is reduced one tenth, and the diſtance at which it drops 16 feet from the line of its direction. This table is calculated by the reſiſtance obſerved in Mr Robins's experiments. The firſt column is the weight of the ball in pounds. The ſecond column remains the ſame whatever be the initial velocity; but the third column depends on the velocity. It is here given for the velocity which is very uſual in military ſervice, and its uſe is to aſſiſt us in directing the gun to the mark.— If the mark at which a ball of 24 pounds is directed is 474 yards diſtant, the axis of the piece muſt be pointed 16 feet higher than the mark. Theſe deflections from the line of direction are nearly as the ſquares of the diſtances.

I.	II.	III.
2	92	420
4	121	428
9	159	456
18	200	470
32	272	479

The next table contains the ranges in yards of a 24 pound ſhot, projected at an elevation of 45°, with the different velocities in feet per ſecond, expreſſed in the firſt column. The ſecond column contains the diſtances to which the ball would go in vacuo in a horizontal plane; and the third contains the diſtances to which it will go through the air. The fourth column is added, to ſhow the height to which it riſes in the air; and the fifth ſhows the ranges corrected for the diminution of the air's denſity as the bullet aſcends, and may therefore be called the *corrected range.*

I.	II.	III.	IV.	V.
200	416	349	106	360
400	1664	1121	338	1150
600	3740	1812	606	1859
800	6649	2373	866	2435
1000	10390	2845	1138	2919
1200	14961	3259	1378	3343
1400	20364	3640	1606	3734
1600	26597	3950	1814	4050
1800	33663	4235	1992	4345
2000	41559	4494	2168	4610
2200	50286	4720	2348	4842
2400	59846	4917	2460	5044
2600		5106	2630	5238
2800		5293	2762	5430
3000		5455	2862	5596
3200				5732

95
Uſe of the laſt table.

The initial velocities can never be puſhed as far as we have calculated for in this table; but we mean it for a table of more extenſive uſe than appears at firſt ſight. Recollect, that while the proportion of the velocity at the vertex to the terminal velocity remains the ſame, the curves will be ſimilar: therefore, if the initial velocities are as the ſquare roots of the diameters of the balls, they will deſcribe ſimilar curves, and the ranges will be as the diameters of the balls.

Therefore, to have the range of a 12 pound ſhot, if projected at an elevation of 45, with the velocity 1500; ſuppoſe the diameter of the 12 pounder to be *d*, and that of the 24 pounder D; and let the velocities be v and V: Then ſay, $\sqrt{d} : \sqrt{D} = 1500$, to a fourth proportional V. If the 24 pounder be projected with the velocity V, It will deſcribe a curve ſimilar to that deſcribed by the 12 pounder, having the initial velocity 1500. Therefore find (by interpolation) the range of the 24 pounder, having the initial velocity V. Call this R. Then $D : d = R : r$, the range of the 12 pounder which was wanted, and which is nearly 3380 yards.

We ſee by this table the immenſe difference between the motions through the air and in a void. We ſee that the ranges through the air, inſtead of increaſing in the duplicate ratio of the initial velocities, really increaſe ſlower than thoſe velocities in all caſes of military ſervice; and in the moſt uſual caſes, viz. from 800 to 1600, they increaſe nearly as the ſquare-roots of the velocities.

A ſet of ſimilar tables, made for different elevations, would almoſt complete what can be done by theory, and would be much more expeditious in their uſe than Mr Euler's Trajectories, computed with great labour by his Engliſh tranſlator.

The ſame table may alſo ſerve for computing the ranges of bomb-ſhells. We have only to find what muſt be the initial velocity of the 24 pound ſhot which correſponds to the propoſed velocity of the ſhell. This muſt be deduced from the diameter and weight of the ſhell, by making the velocity of the 24 pounder ſuch, that the ratio of its weight to the reſiſtance may be the ſame as in the ſhell.

Plate CCCCXVIII
96
Relation of the different quantities in it.

That the reader may ſee with one glance the relation of thoſe different quantities, we have given this table, expreſſed in a figure (fig. 10). The abſciſſa, or axis DA, is the ſcale of the initial velocities in feet per ſecond, meaſured on a ſcale of 400 equal parts in an inch. The ordinates to the curve ACG expreſs the yards of the range on a ſcale containing 800 yards in an inch. The ordinates to the curve A α γ expreſs (by the ſame ſcale) the height to which the ball riſes in the air.

The ordinate BC (drawn through the point of the abſciſſa which correſponds to the initial velocity 2000 is divided in the points 4, 9, 12, 18, 24, 32, 42, in the ratio of the diameters of cannon-ſhot of different weights; and the ſame ordinate is produced on the other ſide of the axis, till BO be equal to BA; and then BO is divided in the ſubduplicate ratio of the ſame diameters. Lines are drawn from the point A, and from any point D of the abſciſſa, to theſe diviſions.

We ſee diſtinctly by this figure how the effect of the initial velocity gradually diminiſhes, and that in very great velocities the range is very little increaſed by its augmentation. The dotted curve APQR, ſhows what the ranges in vacuo would be.

By this figure may the problems be ſolved. Thus, to find the range of the 12 pounder, with the initial velocity 1500. Set off 1500 from B to F; draw FH parallel to the axis, meeting the line 12A in H; draw the ordinate HK; draw KL parallel to the axis, meeting 24 B in L; draw the ordinate LM, cutting 12 B in N. MN is the range required.

If curves, ſuch as ACG, were laid down in the ſame manner for other elevations, all the problems might be ſolved with great diſpatch, and with much more accuracy than the theory by which the curves are drawn can pretend to.

PROJECTION OF THE SPHERE.

Stereographic Projection of the Sphere.

THE PROJECTION of the SPHERE is a perſpective repreſentation of the circles on the ſurface of the ſphere; and is variouſly denominated according to the different poſitions of the eye and plane of projection.

There are three principal points of projection; the *ſtereographic*, the *orthographic*, and *gnomonic*. In the ſtereographic projection the eye is ſuppoſed to be placed on the ſurface of the ſphere; in the orthographic it is ſuppoſed to be at an infinite diſtance; and in the gnomonic projection the eye is placed at the centre of the ſphere. Other kinds of its projection are, the *globular*, *Mercator's*, *ſcenographic*, &c. for which ſee the articles GEOGRAPHY, NAVIGATION, PERSPECTIVE, &c.

DEFINITIONS.

1. The plane upon which the circles of the ſphere are deſcribed, is called the *plane of projection*, or the *primitive circle*. The pole of this circle is the *pole of projection*, and the place of the eye is the *projecting point*.

2. The *line of meaſures* of any circle of the ſphere is that diameter of the primitive, produced indefinitely, which paſſes through the centre of the projected circle.

AXIOM.

The projection, or repreſentation of any point, is where the ſtraight line drawn from it to the projecting point interſects the plane of projection.

SECTION I.

Of the Stereographic Projection of the Sphere.

IN the ſtereographic projection of the ſphere, the eye is placed on the ſurface of the ſphere in the pole of the great circle upon which the ſphere is to be projected. The projection of the hemiſphere oppoſite to the eye falls within the primitive, to which this projection is generally limited: it, however, may be extended to the other hemiſphere, or that wherein the eye is placed, the projection of which falls without the primitive.

As all circles in this projection are projected either into circles or ſtraight lines, which are eaſily deſcribed, it is, therefore more generally underſtood, and by many preferred to the other projections.

PROPOSITION I. THEOREM I.

Every great circle which paſſes through the projecting point is projected into a ſtraight line paſſing through the centre of the primitive; and every arch of it, reckoned from the other pole of the primitive, is projected into its ſemitangent.

Stereographic Projection of the Sphere. Plate CCCCXIX.

Let ABCD (fig. 1.) be a great circle paſſing thro' A, C, the poles of the primitive, and interſecting it in the line of common ſection BED, E being the centre of the ſphere. From A, the projecting point, let there be drawn ſtraight lines AP, AM, AN, AQ, to any number of points P, M, N, Q, in the circle ABCD: theſe lines will interſect BED, which is in the ſame plane with them. Let them meet it in the points *p*, *m*, *n*, *q*; then *p*, *m*, *n*, *q*, are the projections of P, M, N, Q: hence the whole circle ABCD is projected into the ſtraight line BED, paſſing through the centre of the primitive.

Again, becauſe the pole C is projected into E, and the point M into *m*; therefore the arch CM is projected into the ſtraight line E*m*, which is the ſemitangent of the arch CM to the radius AE. In the like manner, the arch CP is projected into its ſemitangent E*p*, &c.

COROLLARIES.

1. Each of the quadrants contiguous to the projecting point is projected into an indefinite ſtraight line, and each of thoſe that are remote into a radius of the primitive.

2. Every ſmall circle which paſſes through the projecting point is projected into that ſtraight line which is its common ſection with the primitive.

3. Every ſtraight line in the plane of the primitive, and produced indefinitely, is the projection of ſome circle on the ſphere paſſing through the projecting point.

4. The projection of any point in the ſurface of the ſphere, is diſtant from the centre of the primitive, by the ſemitangent of the diſtance of that point from the pole oppoſite to the projecting point.

PROPOSITION II. THEOREM II.

Every circle on the ſphere which does not paſs through the projecting point is projected into a circle.

If the given circle be parallel to the primitive, then a ſtraight line drawn from the projecting point to any point in the circumference, and made to revolve about the circle, will deſcribe the ſurface of a cone; which being cut by the plane of projection parallel to the baſe, the ſection will be a circle. Se *Conic-Sections*.

But if the circle MN (fig. 2.) be not parallel to the primitive circle BD, let the great circle ABCD, paſſing through the projecting point, cut it at right angles in the diameter MN, and the primitive in the diameter BD. Through M, in the plane of the great circle, let MF be drawn parallel to BD; let AM, AN be joined and meet BD in *mn*. Then, becauſe AB, AD are quadrants, and BD, MF parallel, the arch AM is equal to AF, and the angle AMF or A *mn* is equal to ANM. Hence the conic ſurface deſcribed by the revolution of AM about the circle MN is cut by the primitive in a ſubcontrary poſition; therefore the ſection is in this caſe likewiſe a circle.

Corollaries.

1. The centres and poles of all circles parallel to the primitive have their projections in its centre.

2. The centre and poles of every circle inclined to the primitive have their projections in the line of meaſures.

3. All projected great circles cut the primitive in two points diametrically oppoſite; and every circle in the plane of projection, which paſſes through the extremities of a diameter of the primitive, or through the projections of two points that are diametrically oppoſite on the ſphere, is the projection of ſome great circle.

4. A tangent to any circle of the ſphere, which does not paſs through the projecting point is projected into a tangent to that circle's projection; alſo, the circular projections of tangent circles touch one another.

5. The extremities of the diameter, on the line of meaſures of any projected circle, are diſtant from the centre of the primitive by the ſemitangents of the leaſt and greateſt diſtances of the circle on the ſphere, from the pole oppoſite to the projecting point.

6. The extremities of the diameter, on the line of meaſures of any projected great circle, are diſtant from the centre of the primitive by the tangent and cotangent of half the great circle's inclination to the primitive.

7. The radius of any projected circle is equal to half the ſum, or half the difference of the ſemitangents of the leaſt and greateſt diſtances of the circle from the pole oppoſite to the projecting point, according as that pole is within or without the given circle.

Proposition III. Theorem III.

An angle formed by two tangents at the ſame point in the ſurface of the ſphere, is equal to the angle formed by their projections.

Plate CCCCXIX. Let FGI and GH (fig. 3.) be the two tangents, and A the projecting point; let the plane AGF cut the ſphere in the circle AGL, and the primitive in the line BML. Alſo, let MN be the line of common ſection of the plane AGH with the primitive: then the angle $FGH=LMN$. If the plane FGH be parallel to the primitive BLD, the propoſition is manifeſt. If not, through any point K in AG produced, let the plane FKH, parallel to the primitive, be extended to meet FGH in the line FH. Then, becauſe the plane AGF meets the two parallel planes BLD, FKH, the lines of common ſection LM, FK are parallel; therefore the angle $AML=AKF$. But ſince A is the pole of BLD, the chords, and conſequently the arches AB AL, are equal, and the arch ABG is the ſum of the arches AL, BG; hence the angle AML is equal to an angle at the circumference ſtanding upon AG, and therefore equal to AGI or FGK; conſequently the angle $FGK=FKG$, and the ſide $FG=FK$. In like manner $HG=HK$: hence the triangles GHF, KHF are equal, and the angle $FGH=FKH=LMN$.

Corollaries.

1. An angle contained by any two circles of the ſphere is equal to the angle formed by their projections. For the tangents to theſe circles on the ſphere are projected into ſtraight lines, which either coincide with, or are tangents to, their projections on the primitive.

2. An angle contained by any two circles of the ſphere is equal to the angle formed by the radii of their projections at the point of interſection.

Proposition IV. Theorem IV.

The centre of a projected great circle is diſtant from the centre of the primitive; the tangent of the inclination of the great circle to the primitive, and its radius, is the ſecant of its inclination.

Let MNG (fig. 4.) be the projection of a great circle, meeting the primitive in the extremities of the diameter MN, and let the diameter BD, perpendicular to MN, meet the projection in F, G. Biſect FG in H, and join NH. Then, becauſe any angle contained by two circles of the ſphere is equal to the angle formed by the radii of their projections at the point of interſection; therefore the angle contained by the propoſed great circle and the primitive is equal to the angle ENH, of which EH is the tangent, and NH the ſecant, to the radius of the primitive.

Corollaries.

2. All circles which paſs through the points M, N are the projections of great circles, and have their centres in the line BG; and all circles which paſs through the points F, G are the projections of great circles, and have their centres in the line HI, perpendicular to BG.

2. If NF, NH be continued to meet the primitive in L, F; then BL is the meaſure of the great circle's inclination to the primitive; and $MT=2BL$.

Proposition V. Theorem V.

The centre of projection of a leſs circle perpendicular to the primitive, is diſtant from the centre of the primitive, the ſecant of the diſtance of the leſs circle from its neareſt pole; and the radius of projection is the tangent of that diſtance.

Let MN (fig. 5.) be the given leſs circle perpendicular to the primitive, and A the projecting point Draw AM, AN to meet the diameter BD produced in G and H; then GH is the projected diameter of the leſs circle: biſect GH in C, and C will be its centre; join NE, NC. Then becauſe AE, NI are parallel, the angle $INE=NEA$; but $NEA=2NMA=2NHG=NCG$: hence $ENC=INE+INC=NCG+INC=$ a right angle; and therefore NC is a tangent to the primitive at N; but the arch ND is the diſtance of the leſs circle from its neareſt pole D: hence NC is the tangent, and EC the ſecant of the diſtance of the leſs circle from its pole to the radius of the primitive.

Stereographic Projection of the Sphere.

Proposition VI. Theorem VI.

The projection of the poles of any circle, inclined to the primitive, are, in the line of meaſures, diſtant from the centre of the primitive, the tangent, and cotangent, or half its inclination.

Plate CCCCXIX.

Let MN (fig. 6.) be a great circle perpendicular to the primitive ABCD, and A the projecting point; then P, p are the poles of MN, and of all its parallels mn, &c. Let AP, Ap meet the diameter BD in Ff, which will therefore be the projected poles of MN and its parallels. The angle BEM is the inclination of the circle MEN, and its parallels, to the primitive: and becauſe BC and MP are quadrants, and MC common to both; therefore PC=BM: and hence PEC is alſo the inclination of MN and its parallels. Now EF is the tangent of EAF, or of half the angle PEC the inclination; and Ef is the tangent of the angle EAf; but EAf is the complement of EAF, hence Ef is the cotangent of half the inclination.

Corollaries.

1. The projection of that pole which is neareſt to the projecting point is without the primitive, and the projection of the other within.
2. The projected centre of any circle is always between the projection of its neareſt pole and the centre of the primitive; and the projected centres of all circles are contained between their projected poles.

Proposition VII. Theorem VII.

Equal arches of any two great circles of the ſphere will be intercepted between two other circles drawn on the ſphere through the remote poles of thoſe great circles.

Let AGB, CFD (fig. 7.) be two great circles of the ſphere, whoſe remote poles are E, P; through which draw the great circle PBEC, and leſs circle PGE, interſecting the great circles AGB, CFD, in the points B, G, and D, F; then the arch BG is equal to the arch DF.

Becauſe E is the pole of the circle AGB, and P the pole of CFD, therefore the arches EB, PD are equal; and ſince BD is common to both, hence the arch ED is equal to the arch PB. For the ſame reaſon, the arches EF, PG are equal; but the angle DEF is equal to the angle BPG: hence theſe triangles are equal, and therefore the arch DF is equal to the arch BG.

Proposition VIII. Theorem VIII.

If from either pole of a projected great circle, two ſtraight lines be drawn to meet the primitive and the projection, they will intercept ſimilar arches of theſe circles.

On a plane of projection AGB (fig. 7.) let the great circle CFD be projected into cfd, and its pole P into p; through p draw the ſtraight lines pd, pf, then are the arches GB, fd ſimilar.

Since pd lies both in the plane AGB and APBE, it is in their common ſection, and the point B is alſo in their common ſection; therefore pd paſſes through the point B. In like manner it may be ſhown that the line pf paſſes through G. Now the points D, F are projected into d, f: hence the arches FD, fd are ſimilar; but GB is equal to FD, therefore the intercepted arch of the primitive GB is ſimilar to the projected arch fd.

Corollary.

Hence, if from the angular point of a projected ſpherical angle two ſtraight lines be drawn through the projected poles of the containing ſides, the intercepted arch of the primitive will be the meaſure of the ſpherical angle.

Proposition IX. Problem I.

To deſcribe the projection of a great circle through two given points in the plane of the primitive.

Let P and B be given points, and C the centre of the primitive.

1. When one point P (fig. 8.) is the centre of the primitive, a diameter drawn through the given points will be the great circle required.
2. When one point P (fig. 9.) is in the circumference of the primitive. Through P draw the diameter PD; and an oblique circle deſcribed through the three points P, B, D, will be the projection of the required great circle.
3. When the given points are neither in the centre nor circumference of the primitive. Through either of the given points P (fig. 10.) draw the diameter ED, and at right angles thereto draw the diameter FG. From F through P draw the ſtraight line FPH, meeting the circumference in H: draw the diameter HI, and draw the ſtraight line FIK, meeting ED produced in D; then an arch, terminated by the circumference, being deſcribed through the three points P, B, K, will be the great circle.

Proposition X. Problem II.

To deſcribe the repreſentation of a great circle about any given point as a pole.

Let P be the given pole, and C the centre of the primitive.

1. When P (fig. 8.) is in the centre of the primitive, then the primitive will be the great circle required.
2. When the pole P (fig. 11.) is in the circumference of the primitive. Through P draw the diameter PE, and the diameter AB drawn at right angles to PE will be the projected great circle required.
3. When the given pole is neither in the centre nor circumference of the primitive. Through the pole P (fig. 12.) draw the diameter AB, and draw the diameter DE perpendicular to AB; through E and P draw the ſtraight line EPF, meeting the circumference in F. Make FC equal to FD; through E and G draw the ſtraight line EGH, meeting the diameter AB produced if neceſſary in H; then from the centre H, with the radius HE, deſcribe the oblique circle DIE, and it will be the projection of the great circle required.

Plate CCCCXX.

Or, make DK equal to FA; join EK, which interſects the diameter AB in I; then through the three points D, I, E, deſcribe the oblique circle DIE.

Proposition XI. Problem III.

To find the poles of a great circle.

1. When the given great circle is the primitive, its centre is the pole.

2. To

Plate CCCCXIX. Plate CCCCXX.

2. To find the pole of the right circle ABC (fig. 11.) Draw the diameter PE perpendicular to the given circle AB; and its extremities P, E are the poles of the circle ACB.

3. To find the pole of the oblique circle DEF (fig. 13.) Join DF, and perpendicular thereto draw the diameter AB, cutting the given oblique circle DEF in E. Draw the ſtraight line FEG, meeting the circumference in G. Make GI, GH, each equal to AD; then FI being joined, cuts the diameter AB in P, the lower pole; through F and H draw the ſtraight line FHp, meeting the diameter AB produced in p, which will be the oppoſite or exterior pole.

Proposition XII. Problem IV.

To deſcribe a leſs circle about any given point as a pole, and at any given diſtance from that pole.

1. When the pole of the leſs circle is in the centre of the primitive; then from the centre of the primitive, with the ſemitangent of the diſtance of the given circle from its pole, deſcribe a circle, and it will be the projection of the leſs circle required.

2. If the given pole is in the circumference of the primitive, from C (fig. 14.), the centre of the primitive, ſet off CE the ſecant of the diſtance of the leſs circle from its pole P; then from the centre E, with the tangent of the given diſtance, deſcribe a circle, and it will be the leſs circle required. Or, make PG, PF each equal to the chord of the diſtance of the leſs circle from its pole. Through B, G, draw the ſtraight line BGD meeting CP produced in D: biſect GD in H, and draw HE perpendicular to GD; and meeting PD in E, then E is the centre of the leſs circle.

3. When the given pole is neither in the centre nor circumference of the primitive. Through P (fig. 15.), the given pole, and C the centre of the primitive, draw the diameter AB, and draw the diameter DE perpendicular to AB; join EP, and produce it to meet the primitive in p; make pF, pG, each equal to the chord of the diſtance of the leſs circle from its pole; join EF which interſects the diameter AB in H; from E through G draw the ſtraight line EGI, meeting the diameter AB produced in I; biſect HI in K: Then a circle deſcribed from the centre K, at the diſtance KH or KI, will be the projection of the leſs circle.

Proposition XIII. Problem V.

To find the poles of a given leſs circle.

The poles of a leſs circle are alſo thoſe of its parallel great circle. If therefore the parallel great circle be given, then its poles being found by Prob. III. will be thoſe of the leſs circle. But if the parallel great circle be not given, let HMIN (fig. 15.) be the given leſs circle. Through its centre, and C the centre of the primitive, draw the line of meaſures IAHB; and draw the diameter DE perpendicular to it, alſo draw the ſtraight line EHF meeting the primitive in F; make Fp equal to the chord of the diſtance of the leſs circle from its pole; join Ep, and its interſection P with the diameter AB is the interior pole. Draw the diameter pCL through E and L, draw ELq meeting the diameter AB produced in q; then q is the external pole. Or thus: Join EI interſecting the primitive in G; join alſo EH, and produce it to meet the primitive in F, biſect the arch GF in p; from E to p draw the ſtraight line EPp, and P is the pole of the given leſs circle.

Proposition XIV. Problem VI.

To meaſure any arch of a great circle.

1. Arches of the primitive are meaſured on the line of chords.

2. Right circles are meaſured on the line of ſemitangents, beginning at the centre of the primitive. Thus, the meaſure of the portion AC (fig. 16.) of the right circle DE, is found by applying it to the line of ſemitangents. The meaſure of the arch DB is found by ſubtracting that of BC from 90°: the meaſure of the arch AF, lying partly on each ſide of the centre, is obtained by adding the meaſures of AC and CF. Laſtly, To meaſure the part AB, which is neither terminated at the centre or circumference of the primitive, apply CA to the line of ſemitangents; then CB, and the difference between the meaſures of theſe arches, will be that of AB.

Or thus, Draw the diameter GH perpendicular to DE; then from either extremity, as D, of this diameter, draw lines through the extremities of the arch intended to be meaſured; and the intercepted portion of the primitive applied to the line of chords will give the meaſure of the required arch. Thus IK applied to the line of chords will give the meaſure of AB.

3. To meaſure an arch of an oblique circle: draw lines from its pole through the extremities of the arch to meet the primitive, then the intercepted portion of the primitive applied to the line of chords will give the meaſure of the arch of the oblique circle. Thus, let AB (fig. 17.), be an arch of an oblique circle to be meaſured, and P its pole; from P draw the lines PAD, PBE meeting the primitive in B and E; then the arch DE applied to the line of chords will give the meaſure of the arch of the oblique circle AB.

Proposition XV. Problem VII.

To meaſure any arch of a leſs circle.

Let DEG (fig. 18.) be the given leſs circle, and DE the arch to be meaſured: find its internal pole P; and deſcribe the circle AFI parallel to the primitive, and whoſe diſtance from the projecting point may be equal to the diſtance of the given leſs circle from its pole P: then join PD, PE, which produce to meet the parallel circle in A and F. Now AF applied to a line of chords will give the meaſure of the arch DE of the given leſs circle.

Proposition XVI. Problem VIII.

To meaſure any ſpherical angle.

1. If the angle is at the centre of the primitive, it is meaſured as a plane angle.

2. When the angular point is in the circumference of the primitive; let A (fig. 19.) be the angular point, and ABE an oblique circle inclined to the primitive. Through P, the pole of ABE, draw the line APp meeting the circumference in p: then the arch Ep is the meaſure of the angle BAD, and the arch AFp is the meaſure of its ſupplement BAF: alſo pF is the meaſure of the angle BAC, and pED that of its ſupplement.

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Plate CCCCXX.

3. If the angular point is neither at the centre nor circumference of the primitive. Let A (fig. 20.) be the angular point, and DAH, or GAF the angle to be meaſured, P the pole of the oblique circle DAF, and p the pole of GAH: then from A, through the points Pp, draw the ſtraight lines APM, ApN, and the arch MN will be the meaſure of the angle DAH; and the ſupplement of MN will be the meaſure of the angle HAF or DAG.

Proposition XVII. Problem IX.

To draw a great circle perpendicular to a projected great circle, and through a point given in it.

Find the pole of the given circle, then a great circle deſcribed through that pole and the given point will be perpendicular to the given circle. Hence if the given circle be the primitive, then a diameter drawn through the given point will be the required perpendicular. If the given circle is a right one, draw a diameter at right angles to it; then through the extremities of this diameter and the given point deſcribe an oblique circle, and it will be perpendicular to that given. If the given circle is inclined to the primitive, let it be repreſented by BAD (fig. 21.), whoſe pole is P, and let A be the point through which the perpendicular is to be drawn: then, by Prob. I. deſcribe a great circle through the points P and A, and it will be perpendicular to the oblique circle BAD.

Proposition XVIII. Problem X.

Through a point in a projected great circle, to deſcribe another great circle to make a given angle with the former, provided the meaſure of the given angle is not leſs than the diſtance between the given point and circle.

Let the given circle be the primitive, and let A (fig. 19.) be the angular point. Draw the diameters AE, DF perpendicular to each other; and make the angle CAG equal to that given, or make CG equal to the tangent of the given angle; then from the centre G, with the diſtance GC, deſcribe the oblique circle ABE, and it will make with the primitive an angle equal to that given.

If the given circle be a right one, let it be APB (fig. 22.) and let P be the given point. Draw the diameter GH perpendicular to AB; join GP, and produce it to a; make Hb equal to twice Aa; and Gb being joined interſects AB in C. Draw CD perpendicular to AB, and equal to the cotangent of the given angle to the radius PC; or make the angle CPD equal to the complement of that given: then from the centre D, with the radius DP, deſcribe the great circle FPE, and the angle APF, or BPE, will be equal to that given.

If APB (fig. 23.) is an oblique circle. From the angular point P, draw the lines PG, PC through the centres of the primitive and given oblique circle. Through C, the centre of APB, draw GCD at right angles to PG; make the angle GPD equal to that given; and from the centre D, with the radius DP, deſcribe the oblique circle FPE, and the angle APF, or BPE, will be equal to that propoſed.

Proposition XIX. Problem XI.

Any great circle cutting the primitive being given, to deſcribe another great circle which ſhall cut the given one in a propoſed angle, and have a given arch intercepted between the primitive and given circles.

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If the given circle be a right one, let it be repreſented by APC (fig. 24.); and at right angles thereto draw the diameter BPM; make the angle BPF equal to the complement of the given angle, and PF equal to the tangent of the given arch; and from the centre of the primitive with the ſecant of the ſame arch deſcribe the arch Gg. Through F draw FG parallel to AC, meeting Gg in G; then from the centre G, with the tangent PF, deſcribe an arch no, cutting APC in I, and join GI. Through G, and the centre P, draw the diameter HK; draw PL perpendicular to HK, and IL perpendicular to GI, meeting PL in L; then L will be the centre of the circle HIK, which is that required.

But if the given great circle be inclined to the primitive, let it be ADB (fig. 25.), and E its centre: make the angle BDF equal to the complement of that given, and DF equal to the tangent of the given arch, as before. From P, the centre of the primitive, with the ſecant of the ſame arch, deſcribe the arch Gg, and from E, the centre of the oblique circle, with the extent EF, deſcribe an arch interſecting Gg in G. Now G being determined, the remaining part of the operation is performed as before.

When the given arch exceeds 90°, the tangent and ſecant of its ſupplement are to be applied on the line DF the contrary way, or towards the right; the former conſtruction being reckoned to the left.

Proposition XX. Problem XII.

Any great circle in the plane of projection being given to deſcribe another great circle, which ſhall make given angles with the primitive and given circles.

Let ADC (fig. 26.) be the given circle, and Q its pole. About P, the pole of the primitive, deſcribe an arch mn, at the diſtance of as many degrees as are in the angle which the required circle is to make with the primitive. About Q the pole of the circle ADC, and at a diſtance equal to the meaſure of the angle which the required circle is to make with the given circle ADC, deſcribe an arch on, cutting mn in n. Then about n as a pole, deſcribe the great circle EDF, cutting the primitive and given circle in E and D, and it will be the great circle required.

Scholium.

It will hence be an eaſy matter to conſtruct all the various ſpherical triangles. The reader is, however, referred to the article *Spherical Trigonometry*, for the method of conſtructing them agreeable to this projection; and alſo for the application to the reſolution of problems of the ſphere. For the method of projecting the ſphere upon the plane of the meridian, and of the horizon, according to the ſtereographic projection, ſee the article Geography.

SECTION II.

Of the Orthographic Projection of the Sphere.

The orthographic projection of the ſphere, is that in which the eye is placed in the axis of the plane of pro-

Orthographic Projection of the Sphere.

jection, at an infinite diſtance with reſpect to the diameter of the ſphere; ſo that at the ſphere all the viſual rays are aſſumed parallel, and therefore perpendicular to the plane of projection.

Hence the orthographic projection of any point is where a perpendicular from that point meets the plane of projection: and the orthographic repreſentation of any object is the figure formed by perpendiculars drawn from every point of the object to the plane of projection.

This method of projection is uſed in the geometrical delineation of eclipſes, occultations, and tranſits. It is alſo particularly uſeful in various other projections, ſuch as the analemma. See GEOGRAPHY, &c.

PROPOSITION I. THEOREM I.

Every ſtraight line is projected into a ſtraight line. If the given line be parallel to the plane of projection, it is projected into an equal ſtraight line; but if it is inclined to the primitive, then the given ſtraight line will be to its projection in the ratio of the radius to the coſine of inclination.

Plate CCCXXI.

Let AB (fig. 27.) be the plane of projection, and let CD be a ſtraight line parallel thereto: from the extremities C, D of the ſtraight line CD, draw the lines CE, DF perpendicular to AB; then by 3. of XI. of Eucl. the interſection EF, of the plane CEFD, with the plane of projection, is a ſtraight line: and becauſe the ſtraight lines CD, EF are parallel, and alſo CE, DF; therefore, by 34. of I. of Eucl. the oppoſite ſides are equal; hence the ſtraight line CD, and its projection EF, are equal. Again, let GH be the propoſed ſtraight line, inclined to the primitive; then the lines GE, HF being drawn perpendicular to AB, the intercepted portion EF will be the projection of GH. Through G draw GI parallel to AB, and the angle IGH will be equal to the inclination of the given line to the plane of projection. Now GH being the radius, GI, or its equal EF, will be the coſine of IGH; hence the given line GH is to its projection EF as radius to the coſine of inclination.

COROLLARIES.

1. A ſtraight line perpendicular to the plane of projection is projected into a point.
2. Every ſtraight line in a plane parallel to the primitive is projected into an equal and parallel ſtraight line.
3. A plane angle parallel to the primitive is projected into an equal angle.
4. Any plane rectilineal figure parallel to the primitive is projected into an equal and ſimilar figure.
5. The area of any rectilineal figure is to the area of its projection as radius to the coſine of its inclination.

PROPOSITION II. THEOREM II.

Every great circle, perpendicular to the primitive, is projected into a diameter of the primitive; and every arch of it, reckoned from the pole of the primitive, is projected into its ſine.

Let BFD (fig. 28.) be the primitive, and ABCD a great circle perpendicular to it, paſſing through its poles A, C; then the diameter BED, which is their line of common ſection, will be the projection of the circle ABCD. For if from any point, as G, in the circle ABC, a perpendicular GH fall upon BD, it will alſo be perpendicular to the plane of the primitive: therefore H is the projection of G. Hence the whole circle is projected into BD, and any arch AG into EH equal to GI its ſine.

COROLLARIES.

1. Every arch of a great circle, reckoned from its interſection with the primitive, is projected into its verſed ſine.
2. Every leſs circle perpendicular to the primitive is projected into its line of common ſection with the primitive, which is alſo its own diameter; and every arch of the ſemicircle above the primitive, reckoned from the middle point, is projected into its ſine.
3. Every diameter of the primitive is the projection of a great circle; and every chord the projection of a leſs circle.
4. A ſpherical angle at the pole of the primitive is projected into an equal angle.

PROPOSITION III. THEOREM III.

A circle parallel to the primitive is projected into a circle equal to itſelf, and concentric with the primitive.

Let the leſs circle FIG (fig. 29.) be parallel to the plane of the primitive BND. The ſtraight line HE, which joins their centres, is perpendicular to the primitive; therefore E is the projection of H. Let any radii HI and IN perpendicular to the primitive be drawn. Then IN, HE being parallel, are in the ſame plane; therefore IH, NE, the lines of common ſection of the plane IE, with two parallel planes, are parallel; and the figure IHEN is a parallelogram. Hence NE = IH, and conſequently FIG is projected into an equal circle KNL, whoſe centre is E.

COROLLARY.

The radius of the projection is the coſine of the diſtance of the parallel circle from the primitive, or the ſine of its diſtance from the pole of the primitive.

PROPOSITION IV. THEOREM IV.

An inclined circle is projected into an ellipſe, whoſe tranſverſe axis is the diameter of the circle.

1. Let ELF (fig. 30.) be a great circle inclined to the primitive EBF, and EF their line of common ſection. From the centre C, and any other point K, in EF, let the perpendiculars CB, KI be drawn in the plane of the primitive, and CL, KN, in the plane of the great circle, meeting the circumference in L, N. Let LG, ND be perpendicular to CB, KI; then G, D are the projections of L, N. And becauſe the triangles LCG, NKD are equiangular, $CL^2 : CG^2 :: NK^2 : DK^2$; or $EC^2 : CG^2 :: EKF : DK^2$: therefore the points G, D are in the curve of an ellipſe, of which EF is the tranſverſe axis, and CG the ſemiconjugate axis.

COROLLARIES.

1. In a projected great circle, the ſemiconjugate axis is the coſine of the inclination of the great circle to the primitive.

2. Per-

Orthographic Projection of the Sphere.

2. Perpendiculars to the tranſverſe axis intercept correſponding arches of the projection and the primitive.

3. The eccentricity of the projection is the ſine of the inclination of the great circle to the primitive.

Plate CCCCXXI.

Caſe 2. Let AQB (fig. 31.) be a leſs circle, inclined to the primitive, and let the great circle LBM, perpendicular to both, interſect them in the lines AB, LM. From the centre O and any other point N in the diameter AB, let the perpendiculars TOP, NQ, be drawn in the plane of the leſs circle, to meet its circumference in T, P, Q. Alſo, from the points A, N, O, B, let AG, NI, OC, BH, be drawn perpendicular to LM; and from P, Q, T, draw PE, QD, TF perpendicular to the primitive; then G, I, C, H, E, D, F, are the projections of theſe points. Becauſe OP is perpendicular to LBM, and OC, PE, being perpendicular to the primitive, are in the ſame plane, the plane COPE is perpendicular to LBM. But the primitive is perpendicular to LBM; therefore the common ſection EC is perpendicular to LBM, and to LM. Hence CP is a parallelogram, and EC = OP. In like manner, FC, DI, are proved perpendicular to LM, and equal to OT, NQ. Thus, ECF is a ſtraight line, and equal to the diameter PT. Let QR, DK be parallel to AB, LM; then RO = NQ = DI = KC, and PR × RT = EK × KF. But AO : CG :: NO : CI; therefore $AO^2 : CG^2 :: QR^2 : DK^2$ and $EC^2 : CG. : EKF : DK^2$.

Corollaries.

1. The tranſverſe axis is to the conjugate as radius to the coſine of the circle's inclination to the primitive.

2. Half the tranſverſe axis is the coſine of half the ſum of the greateſt and leaſt diſtances of the leſs circle from the primitive.

3. The extremities of the conjugate axis are in the line of meaſures, diſtant from the centre of the primitive by the coſines of the greateſt and leaſt diſtances of the leſs circle from the primitive.

4. If from the extremities of the conjugate axis of any elliptical projection perpendiculars be drawn (in the ſame direction if the circle do not interſect the primitive, but if otherwiſe in oppoſite directions), they will interſect an arch of the primitive, whoſe chord is equal to the diameter of the circle.

Proposition V. Theorem V.

The projected poles of an inclined circle are in its line of meaſures diſtant from the centre of the primitive the ſine of the inclination of the circle to the primitive.

Let ABCD (fig. 32.) be a great circle, perpendicular both to the primitive and the inclined circle, and interſecting them in the diameters AC, MN. Then ABCD paſſes through the poles of the inclined circle; let theſe be P, Q; and let P*p*, Q*q*, be perpendicular to AC; *p*, *q* are the projected poles; and it is evident that *p* O = ſine of BP, or MA, the inclination.

Corollaries.

1. The centre of the primitive, the centre of the projection, the projected poles, and the extremities of the conjugate axis, are all in one and the ſame ſtraight line.

2. The diſtance of the centre of projection from the centre of the primitive, is to the coſine of the diſtance of the circle from its own pole, as the ſine of the circle's inclination to the primitive is to the radius.

Orthographic Projection of the Sphere.

Proposition VI. Problem I.

To deſcribe the projection of a circle perpendicular to the primitive, and whoſe diſtance from its pole is equal to a given quantity.

Let PA*p*B (fig. 33.) be the primitive circle, and P, *p* the poles of the right circle to be projected. Then if the circle to be projected is a great circle, draw the diameter AB at right angles to the axis P*p*, and it will be that required. But if the required projection is that of a leſs circle, make PE, PF each equal to the chord of the diſtance of the leſs circle from its pole; join EF, and it will be the projection of the leſs circle required.

Proposition VII. Problem II.

Through a given point in the plane of the primitive to deſcribe the projection of a great circle, having a given inclination to the primitive.

1. When the given inclination is equal to a right angle, a ſtraight line drawn through the centre of the primitive and the given point will be the projection required.

2. When the given inclination is leſs than a right angle, and the given point in the circumference of the primitive. Let R (fig. 34.) be a point given in the circumference of the primitive, through which it is required to draw the projection of a great circle, inclined to the primitive in an angle meaſured by the arch QP of the primitive.

Through the given point R draw the diameter RCS, and draw GC*g* at right angles to it. Make the arch GV of the primitive equal to QP, and draw VA at right angles to GC; and in G*g*, towards the oppoſite parts of C, take CB equal to AC; then, with the greater axis RS, and leſs axis AB, deſcribe an ellipſe, and it will be the projection of the oblique circle required.

3. When the diſtance of the given point from the primitive is equal to the coſine of the given inclination.

Every thing remaining as in the preceding caſe; let A be the given point, and AC the coſine of an arch GV, equal to the given arch QP; then drawing the diameter RCS at right angles to ACB, the ellipſe deſcribed with the given axis RS, AB will be the projection of the inclined circle.

4. When the diſtance of the given point from the centre of the primitive is leſs than the ſemidiameter of the primitive, but greater than the coſine of the given inclination.

Walker on the Sphere, p. 159.

Let D be the given point, through which draw the diameter IC*i*; and at the point D draw DL perpendicular to DC meeting the primitive in L; alſo draw LK, making with LD the angle DLK equal to the complement of the given inclination. Let LK meet DC in K; then will DK be leſs than DC. On DC as a diameter deſcribe a circle, and make DH equal to DK; through H draw a diameter of the primitive RCS, and deſcribe an ellipſe through the points R, D, S, and it will be the projection of the inclined circle.

Proposition VIII. Problem III.

Through two given points in the plane of the primitive to deſcribe the projection of a great circle.

1. If the two given points and the centre of the primitive be in the ſame ſtraight line, then a diameter of the primitive being drawn through theſe points will be the projection of the great circle required.

2. When the two given points are not in the ſame ſtraight line with the centre of the primitive; and one of them is in the circumference of the primitive.

Plate CCCCXXI.

Let D, R, (fig. 34.) be the two given points, of which R is in the circumference of the primitive. Draw the diameter RCS, and GC*g*, FDH perpendicular to it, meeting the primitive in G*g* F. Divide GC, *g*C, in A, B, in the ſame proportion as FH is divided in D; and deſcribe the ellipſe whoſe axes are RS, AB, and centre C; and it will be the projection required.

3. When the given points are within the primitive, and not in the ſame ſtraight line with its centre.

Let D, E (fig. 35.) be the two given points; through C the centre of the primitive draw the ſtraight lines ID*i*, KE*i*; draw DL perpendicular to I*i*, and EO perpendicular to K*k*, meeting the primitive in L, O. Through E, and towards the ſame parts of C, draw EP parallel to DC, and in magnitude a fourth proportional to LD, DC, OE. Draw the diameter CP meeting the primitive in R, S, and deſcribe an ellipſe through the points D and R or S, and it will alſo paſs through E. This ellipſe will be the projection of the propoſed inclined circle.

Proposition IX. Problem IV.

To deſcribe the projection of a leſs circle parallel to the primitive, its diſtance from the pole of the primitive being given.

From the pole of the primitive, with the ſine of the given diſtance of the circle from its pole, deſcribe a circle, and it will be the projection of the given leſs circle.

Proposition X. Problem V.

About a given point as a projected pole to deſcribe the projection of an inclined circle, whoſe diſtance from its pole is given.

Let P (fig. 36.) be the given projected pole, through which draw the diameter G*g*, and draw the diameter H*h* perpendicular thereto. From P draw PL perpendicular to GP meeting the circumference in L; through which draw the diameter L*l*. Make LT, LK each equal to the chord of the diſtance of the leſs circle from its pole, and join TK, which interſects L*l*, in Q. From the points T, Q, K draw the lines FA, QS, KB, perpendicular to G*g*; and make OR, OS, each equal to QT, or QK. Then an ellipſe deſcribed through the points A, S, B, R will be the projection of the propoſed leſs circle.

Proposition XI. Problem VI.

To find the poles of a given projected circle.

1. If the projected circle be parallel to the primitive, the centre of the primitive will be its pole.

2. If the circle be perpendicular to the primitive, then the extremities of a diameter of the primitive drawn at right angles to the ſtraight line repreſenting the projected circle, will be the poles of that circle.

3. When the projected circle is inclined to the primitive.

Let ARBS (fig. 36, 37.) be the elliptical projection of any oblique circle; through the centre of which, and C the centre of the primitive, draw the line of meaſures CBA, meeting the ellipſe in B, A; and the primitive in G, *g*. Draw CH, BK, AT perpendicular to G*g*, meeting the primitive in H, K, T. Biſect the arch KT in L, and draw LP perpendicular to G*g*; then P will be the projected pole of the circle, of which ARBS is the projection.

Proposition XII. Problem VII.

To meaſure any portion of a projected circle, and converſely.

1. When the given projection is that of a great circle.

Let ADEB (fig. 38.) be the given great circle, either perpendicular or inclined to the primitive, of which the portion DE is to be meaſured, and let M*m* be the line of meaſures of the given circle. Through the points D, E draw the lines EG, DF parallel to M*m*; and the arch FG of the primitive will be the meaſure of the arch DE of the great circle, and converſely.

2. When the projection is that of a leſs circle parallel to the primitive.

Plate CCCCXXII.

Let DE (fig. 39.) be the portion to be meaſured, of the leſs circle DEH parallel to the primitive. From the centre C draw the lines CD, CE, and produce them to meet the primitive in the points B, F. Then the intercepted portion BF of the primitive will be the meaſure of the given arch DE of the leſs circle DEH.

3. If the given leſs circle, of which an arch is to be meaſured, is perpendicular to the primitive.

Let ADEB (fig. 40.) be the leſs circle, of which the meaſure of the arch DE is required. Through C, the centre of the primitive, draw the line of meaſures M*m*, and from the interſection O of the given right circle, and the line of meaſures, with the radius OA, or OB, deſcribe the ſemicircle AFGB; through the points D, E draw the lines DF, EG parallel to the line of meaſures, and the arch FG will be the meaſure of DE, to the radius AO. In order to find a ſimilar arch in the circumference of the primitive, join OF, OG, and at the centre C of the primitive, make the angle *m*CH equal to FOG, and the arch *m*H to the radius C*m* will be the meaſure of the arch DE.

4. When the given projection is of a leſs circle inclined to the primitive.

Let RDS (fig. 41.) be the projection of a leſs circle inclined to the primitive, and DE a portion of that circle to be meaſured. Through O the centre of the projected circle, and C the centre of the primitive, draw the line of meaſures M*m*; and from the centre O, with the radius OR, or OS, deſcribe the ſemicircle RGFS; through the points D, E draw the lines DF, EG parallel to the line of meaſures, and FG will be the meaſure of the arch DE to the radius OR, or OS. Join OF, OG, and make the angle *m*CH equal to

FOG, and the arch mH of the primitive will be the meaſure of the arch DE of the inclined circle RDS.

The converſe of this propoſition, namely, to cut off an arch from a given projected circle equal to a given arch of the primitive, is obvious.

The above operation would be greatly ſhortened by uſing the line of ſines in the ſector.

It ſeems unneceſſary to inſiſt farther on this projection, eſpecially as the reader will ſee the application of it to the projection of the ſphere on the planes of the *Meridian*, *Equator*, and *Horizon* in the article Geography; and to the delineation of *Eclipſes* in the article Astronomy. The *Analemma*, Plate CCXII. in the article Geography, is alſo according to this projection; and the method of applying it to the ſolution of aſtronomical problems is there exemplified.

SECTION III.

Of the Gnomonic Projection of the Sphere.

In this projection the eye is in the centre of the ſphere, and the plane of projection touches the ſphere in a given point parallel to a given circle. It is named *gnomonic*, on account of its being the foundation of dialling: the plane of projection may alſo repreſent the plane of a dial, whoſe centre being the projected pole, the ſemiaxis of the ſphere will be the ſtile or gnomon of the dial.

As the projection of great circles are repreſented by ſtraight lines, and leſs circles parallel to the plane of projection are projected into concentric circles; therefore many problems of the ſphere are very eaſily reſolved. Other problems, however, become more intricate on account of ſome of the circles being projected into ellipſes, parabolas, and hyperbolas.

Proposition I. Theorem I.

Every great circle is projected into a ſtraight line perpendicular to the line of meaſures; and whoſe diſtance from the centre is equal to the cotangent of its inclination, or to the tangent of its neareſt diſtance from the pole of the projection.

Plate cccxxii.

Let BAD (fig. 42.) be the given circle, and let the circle CBED be perpendicular to BAD, and to the plane of projection; whoſe interſection CF with this laſt plane will be the line of meaſures. Now ſince the circle CBED is perpendicular both to the given circle BAD and to the plane of projection, the common ſection of the two laſt planes produced will therefore be perpendicular to the plane of the circle CBED produced, and conſequently to the line of meaſures: hence the given circle will be projected into that ſection; that is, into a ſtraight line paſſing through d, perpendicular to Cd. Now Cd is the cotangent of the angle CdA, the inclination of the given circle, or the tangent of the arch CD to the radius AC.

Corollaries.

1. A great circle perpendicular to the plane of projection is projected into a ſtraight line paſſing through the centre of projection; and any arch is projected into its correſpondent tangent.

2. Any point, as D, or the pole of any circle, is projected into a point d, whoſe diſtance from the pole of projection is equal to the tangent of that diſtance.

3. If two great circles be perpendicular to each other, and one of them paſſes through the pole of projection, they will be projected into two ſtraight lines perpendicular to each other.

4. Hence if a great circle be perpendicular to ſeveral other great circles, and its repreſentation paſs through the centre of projection; then all theſe circles will be repreſented by lines parallel to one another, and perpendicular to the line of meaſures, for repreſentation of that firſt circle.

Proposition II. Theorem II.

If two great circles interſect in the pole of projection, their repreſentations will make an angle at the centre of the plane of projection, equal to the angle made by theſe circles on the ſphere.

For ſince both theſe circles are perpendicular to the plane of projection, the angle made by their interſections with this plane is the ſame as the angle made by theſe circles.

Proposition III. Theorem III.

Any leſs circle parallel to the plane of projection is projected into a circle whoſe centre is the pole of projection, and its radius is equal to the tangent of the diſtance of the circle from the pole of projection.

Let the circle PI (fig. 42.) be parallel to the plane GF, then the equal arches PC, CI are projected into the equal tangents GC, CH; and therefore C, the point of contact and pole of the circle PI and of the projection, is the centre of the repreſentation G, H.

Corollary.

If a circle be parallel to the plane of projection, and 45 degrees from the pole, it is projected into a circle equal to a great circle of the ſphere; and therefore may be conſidered as the primitive circle, and its radius the radius of projection.

Proposition IV. Theorem IV.

A leſs circle not parallel to the plane of projection is projected into a conic ſection, whoſe tranſverſe axis is in the line of meaſures; and the diſtance of its neareſt vertex from the centre of the plane of projection is equal to the tangent of its neareſt diſtance from the pole of projection; and the diſtance of the other vertex is equal to the tangent of the greateſt diſtance.

Any leſs circle is the baſe of a cone whoſe vertex is at A (fig. 43.); and this cone being produced, its interſection with the plane of projection will be a conic ſection. Thus the cone DAF, having the circle DF for its baſe, being produced, will be cut by the plane of projection in an ellipſe whoſe tranſverſe diameter is df; and Cd is the tangent of the angle CAD, and Cf the tangent of CAF. In like manner, the cone AFE, having the ſide AE parallel to the line of meaſures df, being cut by the plane of projection, the ſection will be a parabola, of which f is the neareſt vertex, Gnomonic Projection of the Sphere.

tex, and the point into which E is projected is at an infinite diſtance. Alſo the cone AFG, whoſe baſe is the circle FG, being cut by the plane of projection, the ſection will be a hyperbola; of which f is the neareſt vertex; and GA being produced gives d the other vertex.

Corollaries.

1. A leſs circle will be projected into an ellipſe, a parabola, or hyperbola, according as the diſtance of its moſt remote point is leſs, equal to, or greater than, 90 degrees.

2. If H be the centre, and K, k, l the focus of the ellipſe, hyperbola, or parabola; then $HK = \frac{Ad - Af}{2}$ for the ellipſe; $Hk = \frac{Ad + Af}{2}$ for the hyperbola; and fn being drawn perpendicular to AE $fl = \frac{nE + Ff}{2}$ for the parabola.

Proposition V. Theorem V.

Plate ccccxxii.

Let the plane TW (fig. 44.) be perpendicular to the plane of projection TV, and BCD a great circle of the ſphere in the plane TW. Let the great circle BED be projected into the ſtraight line bek. Draw CQS perpendicular to bk, and Cm parallel to it and equal to CA, and make QS equal to Qm; then any angle QSt is the meaſure of the arch Qt of the projected circle.

Join AQ; then becauſe Cm is equal to CA, the angle QCm equal to QCA, each being a right angle, and the ſide QC common to both triangles; therefore Qm, or its equal QS, is equal QA. Again, ſince the plane ACQ is perpendicular to the plane TV, and bQ to the interſection CQ; therefore bQ is perpendicular both to AQ and QS: hence, ſince AQ and QS are equal, all the angles at S cut the line bQ in the ſame points as the equal angles at A. But by the angles at A the circle BED is projected into the line bQ. Therefore the angles at S are the meaſures of the parts of the projected circle bQ; and S is the dividing centre thereof.

Corollaries.

1. Any great circle bQt is projected into a line of tangents to the radius SQ.

2. If the circle bC paſs through the centre of projection, then the projecting point A is the dividing centre thereof, and Cb is the tangent of its correſpondent arch CB to CA the radius of projection.

Proposition VI. Theorem VI.

Let the parallel circle GLH (fig. 44.) be as far from the pole of projection C as the circle FNI is from its pole; and let the diſtance of the poles C, P be biſected by the radius AO; and draw bAD perpendicular to AO; then any ſtraight line bQt drawn through b will cut off the arches hl, Fn equal to each other in the repreſentations of theſe equal circles in the plane of projection.

Let the projections of the leſs circles be deſcribed. Then, becauſe BD is perpendicular to AO, the arches BO, DO are equal; but ſince the leſs circles are equally diſtant each from its reſpective pole, therefore the arches FO, OH are equal; and hence the arch BF is equal to the arch DH. For the ſame reaſon the arches BN, DL are equal; and the angle FBN is equal to the angle LDH; therefore, on the ſphere, the arches FN, HL are equal. And ſince the great circle BNLD is projected into the ſtraight line bQnl, &c. therefore n is the projection of N, and l that of L; hence fn, hl, the projections of FN, HL reſpectively, are equal.

Proposition VII. Theorem VII.

If Fnk, hlg (fig. 45.) be the projections of two equal circles, whereof one is as far from its pole P as the other from its pole C, which is the centre of projection; and if the diſtance of the projected poles C, p, be divided in o, ſo that the degrees in Co, op be equal, and the perpendicular oS be erected to the line of meaſures gh. Then the line pn, Cl drawn from the poles C, p, through any point Q in the line oS, will cut off the arches Fn, hl equal to each other, and to the angle QCp.

The great circle AO perpendicular to the plane of the primitive is projected into the ſtraight line oS perpendicular to gh, by Prop. i. Cor. 3. Let Q be the projection of q; and ſince pQ, CQ are ſtraight lines, they are therefore the repreſentations of the arches Pq, Cq of great circles. Now ſince PqC is an iſoſceles ſpherical triangle, the angles PCQ, CPQ are therefore equal; and hence the arches Pq, Cq produced will cut off equal arches from the given circles FI, GH, whoſe repreſentations Fn, hl are therefore equal: and ſince the angle QCp is the meaſure of the arch hl, it is alſo the meaſure of its equal Fn.

Corollary.

Hence, if from the projected pole of any circle a perpendicular be erected to the line of meaſures, it will cut off a quadrant from the repreſentation of that circle.

Proposition VIII. Theorem VIII.

Let Fnk (fig. 45.) be the projection of any circle FI, and p the projection of its pole P. If Cg be the cotangent of CAP, and gB perpendicular to the line of meaſures gC, let CAP be biſected by AO, and the line oB drawn to any point B, and alſo pB cutting Fnk in d; then the angle goB is the meaſures of the arch Fd.

The arch PG is a quadrant, and the angle $goA = gPA + oAP = gAC + oAP = gAC + CAo = gAo$; therefore $gA = go$; conſequently o is the dividing centre of gB, the repreſentation of GA; and hence, by Prop. v. the angle goB is the meaſure of gB. But ſince pg repreſents a quadrant, therefore p is the pole of gB; and hence the great circle pdB paſſing through the pole of the circles gB and Fn will cut off equal arches in both, that is, Fd = gB = angle goB.

Corollary.

The angle goB is the meaſure of the angle gpB.

For the triangle gpB repreſents a triangle on the ſphere, wherein the arch which gB repreſents is equal to the angle which the angle p repreſents; becauſe gp is a quadrant; therefore goB is the meaſure of both.

Proposition IX. Problem I.

To draw a great circle through a given point, and whoſe diſtance from the pole of projection is equal to a given quantity.

Plate ccccxxii.

Let ADB (fig. 46.) be the projection, C its pole or centre, and P the point through which a great circle is to be drawn: through the points P, C draw the ſtraight line PCA, and draw CE perpendicular to it: make the angle CAE equal to the given diſtance of the circle from the pole of projection C; and from the centre C, with the radius CE, deſcribe the circle EFG: through P draw the ſtraight line PIK, touching the circle EFG in I, and it will be the projection of the great circle required.

Proposition X. Problem II.

To draw a great circle perpendicular to a great circle which paſſes through the pole of projection, and at a given diſtance from that pole.

Let ADB (fig. 46.) be the primitive, and CI the given circle: draw CL perpendicular to CI, and make the angle CLI equal to the given diſtance: then the ſtraight line KP, drawn through I parallel to CL, will be the required projection.

Proposition XI. Problem III.

At a given point in a projected great circle, to draw another great circle to make a given angle with the former; and, converſely, to meaſure the angle contained between two great circles.

Let P (fig. 47.) be the given point in the given great circle PB, and C the centre of the primitive: through the points P, C draw the ſtraight line PCG; and draw the radius of the primitive CA perpendicular thereto; join PA; to which draw AG perpendicular: through G draw BGD at right angles to GP, meeting PB in B; biſect the angle CAP by the ſtraight line AO; join BO, and make the angle BOD equal to that given; then DP being joined, the angle BPD will be that required.

If the meaſure of the angle BPD be required, from the points B, D draw the lines BO, DO, and the angle BOD is the meaſure of BPD.

Proposition XII. Problem IV.

To deſcribe the projection of a leſs circle parallel to the plane of projection, and at a given diſtance from its pole.

Let ADB (fig. 46.) be the primitive, and C its centre: ſet the diſtance of the circle from its pole, from B to H, and from H to D; and draw the ſtraight line AED, interſecting CE perpendicular to BC, in the point E: with the radius CE deſcribe the circle EFG, and it is the projection required.

Proposition XIII. Problem V.

To draw a leſs circle perpendicular to the plane of projection.

Plate ccccxxiii.

Let C (fig. 48.) be the centre of projection, and TI a great circle parallel to the propoſed leſs circle: at C make the angles ICN, TCO each equal to the diſtance of the leſs circle from its parallel great circle TI: let CL be the radius of projection, and from the extremity L draw LM perpendicular thereto; make CV equal to LM; or CF equal to CM: then with the vertex V and aſſymptotes CN, CO deſcribe the hyperbola WVK †; or, with the focus F and CV deſcribe the hyperbola, and it will be the perpendicular circle deſcribed.

† See Conic Sections.

Proposition XIV. Problem VI.

To deſcribe the projection of a leſs circle inclined to the plane of projection.

Draw the line of meaſures dp (fig. 49.) and at C, the centre of projection, draw CA perpendicular to dp, and equal to the radius of projection: with the centre A, and radius AC, deſcribe the circle DCFG; and draw RAE parallel to dp: then take the greateſt and leaſt diſtances of the circle from the pole of projection, and ſet them from C to D and F reſpectively, for the circle DF; and from A, the projecting point, draw the ſtraight lines AFf, and ADd; then df will be the tranſverſe axis of the ellipſe: but if D fall beyond the line RE, as at G, then from G draw the line GAD d, and df is the tranſverſe axis of an hyperbola: and if the point D fall in the line RE, as at E, then the line AE will not meet the line of meaſures, and the circle will be projected into a parabola whoſe vertex is f: biſect df in H, the centre, and for the ellipſe take half the difference of the lines Ad, Af, which laid from H will give K the focus: for the hyperbola, half the ſum of Ad, Af being laid from H, will give k its focus: then with the tranſverſe axis df, and focus K, or k, deſcribe the ellipſe dMf, or hyperbola fm, which will be the projection of the inclined circle: for the parabola, make EQ equal to Ff, and draw fn perpendicular to AQ, and make fk equal to one half of nQ: then with the vertex f, and focus k, deſcribe the parabola fm, for the projection of the given circle FE.

Proposition XV. Problem VII.

To find the pole of a given projected circle.

Let DMF (fig. 50.) be the given projected circle, whoſe line of meaſures is DF, and C the centre of projection; from C draw the radius of projection CA, perpendicular to the line of meaſures, and A will be the projecting point: join AD, AF, and biſect the angle DAF by the ſtraight line AP; hence P is the pole. If the given projection be an hyperbola, the angle fAG (fig. 49.), biſected, will give its pole in the line of meaſures; and in a parabola, the angle fAE biſected will give its pole.

Proposition XVI. Problem VIII.

To meaſure any portion of a projected great circle, or to lay off any number of degrees thereon.

Let EP (fig. 51.) be the great circle, and IP a portion thereof to be meaſured; draw ICD perpendicular to IP; let C be the centre, and CB the radius of projection, with which deſcribe the circle EBD; make

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IA equal to IB; then A is the dividing centre of EP; hence AP being joined, the angle IAP is the meaſure of the arch IP.

Or, if IAP be made equal to any given angle, then IP is the correſpondent arch of the projection.

Proposition XVII. Problem IX.

To meaſure any arch of a projected leſs circle, or to lay off any number of degrees on a given projected leſs circle.

Plate CCCCXXIII

Let F *n* (fig. 52.) be the given leſs circle, and P its pole: from the centre of projection C draw CA perpendicular to the line of meaſures GH, and equal to the radius of projection; join AP, and biſect the angle CAP by the ſtraight line AO, to which draw AD perpendicular: deſcribe the circle G *l* H, as far diſtant from the pole of projection C as the given circle is from its pole P; and through any given point *n*, in the projected circle F *n*, draw D *n l*, then H *l* is the meaſure of the arch F *n*

Or let the meaſure be laid from H to *l*, and the line D *l* joined will cut off F *n* equal thereto.

Proposition XVIII. Problem X.

To deſcribe the gnomonic projection of a ſpherical triangle, when three ſides are given; and to find the meaſures of either of its angles.

Let ABC (fig. 53.) be a ſperical triangle whoſe three ſides are given: draw the radius CD (fig. 54.) perpendicular to the diameter of the primitive EF; and at the point D make the angles CDA, CDG, ADI, equal reſpectively to the ſides AC, BC, AB, of the ſpherical triangle ABC (fig. 53.), the lines DA, DG interſecting the diameter EF, produced if neceſſary in the points A and G: make DI equal to DG; then from the centre C, with the radius CG, deſcribe an arch; and from A, with the diſtance AI deſcribe another arch, interſecting the former in B; join AB, CB, and ACB will be the projection of the ſpherical triangle (fig. 53.); and the rectilineal angle ACB is the meaſure of the ſpherical angle ACB (fig. 53).

Proposition XIX. Problem XI.

The three angles of a ſpherical triangle being given, to project it, and to find the meaſures of the ſides.

Let ABC (fig. 55,) be the ſpherical triangle of which the angles are given: conſtruct another ſpherical triangle EFG, whoſe ſides are the ſupplements of the given angles of the triangle ABC; and with the ſides of this ſupplemental triangle deſcribe the gnomonic projection, &c. as before.

It may be obſerved, that the ſupplemental triangle EFG has alſo a ſupplemental part EF *g*; and when the ſides GE, GF, which are ſubſtituted in place of the angles A, B, are obtuſe, their ſupplements *g* E, *g* F are to be uſed in the gnomonic projection of the triangle.

Proposition XX. Problem XII.

Given two ſides, and the included angle of a ſpherical triangle, to deſcribe the gnomonic projection of that triangle, and to find the meaſures of the other parts.

Let the ſides AC, CB, and the angle ACB (fig. 53.), be given: make the angles CDA, CDG (fig. 56.) equal reſpectively to the ſides AC, CB (fig. 53.); alſo make the angle ACB (fig. 56.) equal to the ſpherical angle ACB (fig. 53.), and CB equal to CG, and ABC will be the projection of the ſpherical triangle.

To find the meaſure of the ſide AB: from C draw CL perpendicular to AB, and CM parallel thereto, meeting the circumference of the primitive in M; make LN equal to LM; join AN, BN, and the angle ANB will be the meaſure of the ſide AB.

To find the meaſure of either of the ſpherical angles, as BAC: from D draw DK perpendicular to AD, and make KH equal to KD: from K draw KI perpendicular to CK, and let AB produced meet KI in I, and join HI: then the rectilineal angle KHI is the meaſure of the ſpherical angle BAC. By proceeding in a ſimilar manner, the meaſure of the other angle will be found.

Proposition XXI. Problem XIII.

Two angles and the intermediate ſide given, to deſcribe the gnomonic projection of the triangle; and to find the meaſures of the remaining parts.

Let the angles CAB, ACB, and the ſide AC of the ſpherical triangle ABC (fig. 53.), be given: make the angle CDA (fig. 56.) equal to the meaſure of the given ſide AC (fig. 53.); and the angle ACB (fig. 56.) equal to the angle ACB (fig. 53.); produce AC to H, draw DK perpendicular to AD, and make KH equal to KD; draw KI perpendicular to CK, and make the angle KHI equal to the ſpherical angle CAB: from I, the interſection of KI, HI, to A draw IA, and let it interſect CB in B, and ACB will be the gnomonic projection of the ſpherical triangle ACB (fig. 53). The unknown parts of this triangle may be meaſured by laſt problem.

Proposition XXII. Problem XIV.

Two ſides of a ſpherical triangle, and an angle oppoſite to one of them given, to deſcribe the projection of the triangle; and to find the meaſure of the remaining parts.

Let the ſides AC, CB, and the angle BAC of the ſpherical triangle ABC (fig. 53.) be given: make the angles CDA, CDG (fig. 56.) equal reſpectively to the meaſures of the given ſides AC, BC: draw DK perpendicular to AD, make KH equal to DK, and the angle KHI equal to the given ſpherical angle BAC; draw the perpendicular KI, meeting HI in I; join AI; and from the centre C, with the diſtance CG, deſcribe the arch GB, meeting AI in B, join CB, and ABC will be the rectilineal projection of the ſpherical triangle ABC (fig. 53.) and the meaſures of the unknown parts of the triangle may be found as before.

Proposition XXIII. Problem XV.

Given two angles, and a ſide oppoſite to one of them, to deſcribe the gnomonic projection of the triangle, and to find the meaſures of the other parts.

Let the angles A, B, and the ſide BC of the tri-

angle

Plate CCCCXXIII.

angle ABC (fig. 55.), be given: let the ſupplemental triangle EFE be formed, in which the angles E, F, G, are the ſupplements of the ſides BC, CA, AB reſpectively, and the ſides EF, FG, GE, the ſupplements of the angles C, A, B Now, at the centre C (fig. 56.) make the angles CDA, CDK equal to the meaſures of the ſides GE, GF reſpectively, being the ſupplements of the angles B and A; and let the lines DA, DK interſect the diameter of the primitive EF, in the points A and K: draw DG perpendicular to AD, make GH equal to DG, and at the point H make the angle GHI equal to the angle E, or to its ſupplement; and let EI, perpendicular to CH, meet HI in I, and join AI: then from the centre C, with the diſtance CG, deſcribe an arch interſecting AI in B; join CB, and ABC will be the gnomonic projection of the given triangle ABC (fig. 55.): the ſupplement of the angle ACB (fig. 56.) is the meaſure of the ſide AB (fig. 55.); the meaſures of the other parts are found as before.

It has already been obſerved, that this method of projection has, for the moſt part, been applied to dialling only. However, from the preceding propoſitions, it appears that all the common problems of the ſphere may be more eaſily reſolved by this than by either of the preceding methods of projection; and the facility with which theſe problems are reſolved by this method has given it the preference in dialling. It may not perhaps be amiſs, in this place, to give a brief illuſtration of it in this particular branch of ſcience.

In an horizontal dial, the centre of projection Z (fig. 57.) repreſents the zenith of the place for which the dial is to be conſtructed; ZA the perpendicular height of the ſtyle: the angle ZPA, equal to the given latitude, determines the diſtance ZP of the zenith from the pole; and AP the edge of the ſtyle, which by its ſhadow gives the hour: the angle ZAP, equal alſo to the latitude, gives the diſtance of the equator EQ from the zenith: let E *a* be equal to EA, and *a* will be the dividing point of the equator. Hence if the angles E *a* I, E *a* II, &c. E *a* XI, E *a* X, &c, be made equal to 15°, 30°, &c. the equator will be divided into hours; and lines drawn from P to theſe points of diviſion will be hour lines.

If the dial is either vertical, or inclined to the horizon, then the point Z will be the zenith of that place whoſe horizon is parallel to the plane of the dial: ZE will be the latitude of that place; and the hours on the former dial will now be changed into others, by a quantity equal to the difference of longitude between the given place and that for which the dial is to be conſtructed. Thus if it is noon when the ſhadow of the ſtyle falls on the line *P* X, then the difference of meridians is the angle E *a* X, or 30°. Hence, when a dial is to be conſtructed upon a given plane, either perpendicular or inclined to the horizon, the declination and inclination of that plane muſt be previouſly found.

In an erect direct ſouth dial, its zenith Z is the ſouth point of the horizon, ZP is the diſtance of this point from the pole, and ZE its diſtance from the equator. If the dial is directed to the north, Z, repreſents the north point of the horizon; PZ the diſtance of Z from the pole under the horizon; and ZE the elevation of the equator above the horizon.

If the dial is an erect eaſt or weſt dial, the zenith Z is the eaſt or weſt points of the horizon accordingly, and the pole P is at an infinite diſtance, for the angle ZAP is a right angle; and therefore the line AP will not meet the meridian PZ. The line ZA produced is the equator, and is divided into hours by lines perpendicular to it.

If the plane of the dial is parallel to the equator, its zenith Z coincides with one of the poles of the equator P; and hence the hour lines of this dial are formed by drawing lines from the point Z, containing angles equal to 15°.

In the preceding method, of projection of the ſpheres equal portions of a great circle on the ſphere are repreſented by unequal portions in the plane of projection, and this inequality increaſes with the diſtance from the centre of projection. Hence, in projections of the earth, thoſe places towards the circumference of the projection are very much diſtorted. In order to avoid this inconveniency, M. de la Hire * propoſed, that the eye ſhould be placed in the axis produced, at the diſtance of the ſine of 45° beyond the pole: In this caſe arches of the ſphere and their projections are very nearly proportional to each other. Hence in a map of the earth agreeable to this conſtruction, the axis, inſtead of being divided into a line of ſemitangents, is divided equally, in like manner as the circumference. The map of the world, Plate CCXIV. is conſtructed agreeable to this method of projection.

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* Hiſt. de l'Academie R. des Scien. 1701. See alſo article Geography. p. 650.

PROJECTION, in perſpective denotes the appearance, or repreſentation of an object on the perſpective plane.

The projection, *e. gr.* of a point, as B (Fig. 1. Plate CCCLXXXIII.) is a point *b*, through which the optic ray BE paſſes from the objective point through the plane to the eye; or it is the point wherein the plane cuts the optic ray.

And hence it is eaſily conceived what is meant by the projection of a line, a plane or a ſolid.

Projection in Alchemy, the caſting of a certain imaginary powder, called *powder of projection*, into a crucible, or other veſſel, full of ſome prepared metal, or other matter; which is to be hereby preſently tranſmuted into gold.

Powder of Projection, or of the philoſopher's ſtone, is a powder ſuppoſed to have the virtue of changing any quantity of an imperfect metal, as copper or lead in a more perfect one, as ſilver or gold, by the admixture of a little quantity thereof.

The mark to which alchemiſts direct all their endeavours, is to find the powder of projection; which every one of them has been within an ace of a hundred times. See *Philosopher's Stone*.

PROJECTURE, in architecture, the outjetting and prominency, or emboſſing, which the mouldings and other members have beyond the naked wall, column, &c.

PROLAPSUS, in ſurgery, a prolapſion or falling out of any part of the body from its natural ſituation: thus we ſay, *prolapſus inteſtini*, "a prolapſion of the inteſtine," &c. See SURGERY.

PROLATE, in geometry, an epithet applied to a ſpheroid produced by the revolution of a ſemi-ellipſis about its larger diameter. See SPHEROID.

PROLEGOMENA, in philology, certain preparatory obſervations or diſcourſes prefixed to a book, &c. containing ſomething neceſſary for the reader to be appriſed of, to enable him the better to underſtand the book, or to enter deeper into the ſcience, &c.

PROLEPSIS, a figure in rhetoric, by which we anticipate or prevent what might be objected by the adverſary. See ORATORY, n° 80.

PROLEPTIC, an epithet applied to a periodical diſeaſe which anticipates, or whoſe paroxyſm returns ſooner and ſooner every time; as is frequently the caſe in agues.

PROLIFER FLOS; (*proles*, "an offspring;" and *fero*, "to bear);" a prolific flower, or a flower which from its own ſubſtance produces another; a ſingular degree of luxuriance, to which full flowers are chiefly incident. See BOTANY, p. 428.

PROLIFIC, ſomething that has the qualities neceſſary for generating.

The prolific powers of ſome individuals among mankind are very extraordinary.—Inſtances have been found where children, to the number of ſix, ſeven, eight, nine, and ſometimes ſixteen, have been brought forth after one pregnancy. The wife of Emmanuel Gago, a labourer near Valladolid, was delivered, the 14th of June 1779, of five girls, the two firſt of whom were baptized: the other three were born in an hour after; two of them were baptized; but the laſt, when it came into the world, had every appearance of death. The celebrated Tarſin was brought to bed in the ſeventh month of her pregnancy, at Argenteuil near Paris, 17th July 1779, of three boys, each 14 inches and a half long, and of a girl 13 inches: they were all four baptiſed, but did not live 24 hours.

The public papers for the month of June 1779 made mention of one Maria Ruiz, of the diſtrict of Lucena in Andaluſia, who was ſucceſſively delivered of 16 boys, without any girls; and ſeven of them were ſtill alive on the 17th of Auguſt thereafter. The following, though a recent fact, is almoſt incredible: In the year 1755, a Muſcovite peaſant, named *James Kyrloff*, and his wife, were preſented to the Empreſs of Ruſſia. This peaſant had been twice married, and was then 70 years of age. His firſt wife was brought to bed 21 times; namely, four times of four children each time; ſeven times of three, and ten times of two; making in all 57 children, who were then alive. His ſecond wife, who accompanied him, had already been delivered ſeven times, once of three children, and ſix times of twins, which made 15 children for her ſhare. Thus the Muſcovite patriarch had already had 72 children by two marriages. We are aſſured that the ſultan Muſtapha III. had iſſue by his concubines 580 male children. What number of female children he had, and whether there were twins of both ſexes, we are not informed. Theſe facts ſuppoſe great fecundity; and whatever credit is given to them, we muſt conſider as entirely fabulous what is reported concerning a counteſs of Holland who was delivered of 365 children, of a very ſmall ſize.

PROLIXITY, in diſcourſe, the fault of entering into too minute a detail, or being too long, preciſe, and circumſtantial, even to a degree of tedioulneſs.

PROLOCUTOR of the convocation, the ſpeaker or chairman of that aſſembly. See CONVOCATION.

PROLOGUE, in dramatic poetry, a diſcourſe addreſſed to the audience before the drama or play begins. The original intention was to advertiſe the audience of the ſubject of the piece, and to prepare them to enter more eaſily into the action, and ſometimes to make an apology for the poet.

PROMETHEUS, the ſon of Japetus, ſuppoſed to have been the firſt diſcoverer of the art of ſtriking fire by flint and ſteel; which gave riſe to the fable of his ſtealing fire from heaven: A renowned warrior; but whoſe hiſtory is involved in fable. He flouriſhed about 1687 B. C. The poetical account is, that he formed a man of clay of ſuch exquiſite workmanſhip, that Pallas, charmed with his ingenuity, offered him whatever in heaven could contribute to finiſh his deſign; and for this purpoſe took him up with her to the celeſtial manſions, where he ſtole ſome fire from the chariot of the ſun, which he uſed to animate his image. At this theft Jupiter was ſo enraged, that he ordered Vulcan to chain him down on Mount Caucaſus, and ſent an eagle or vulture to prey on his liver; which every night was renewed, in proportion to the quantity eaten up in the daytime, until at laſt he was delivered by Hercules, who killed the vulture.

PROMETHEUS, in ancient aſtronomy, was the name of a conſtellation of the northern hemiſphere, now called *Hercules*, *Engonaſin*. See ASTRONOMY, n° 406.

1
Promiſe defined.

PROMISE, in ordinary caſes, is a declaration of ſome intention to be put in execution; but in morals is a ſolemn aſſeveration by which one pledges his veracity that he ſhall perform, or cauſe to be performed, the thing which he mentions.

2
How it comes to be binding.

As ſuch a declaration excites expectations in the minds of thoſe to whom it is made; and as to fruſtrate theſe expectations might rouſe indignation, and be followed by conſequences injurious to the perſon, the character, or intereſt, of him who made it—it becomes a matter of prudence in the promiſer to keep his word. And farther, as a certain degree of confidence is found neceſſary to the very exiſtence of civil ſociety, and as others may have acted on the faith of his promiſe, it is now not a matter of prudence only to keep his word—it is a duty which he owes to all who have ſpent their time, their money, or their labour, in conſequence of thoſe expectations which he has warranted them to entertain.

It, then, being conſonant to ſound reaſon, neceſſary to the exiſtence of civil ſociety, and in general the intereſt of both the promiſer and promiſee, that the words of the promiſe ſhould be fulfilled, it has become a maxim in morals that a man is obliged to perform his promiſe.

3
Interpretation of a promiſe ſometimes difficult.

In many inſtances, the great difficulty concerning a promiſe is, how to explain it; for although the grounds of its obligation be thoſe expectations which it has raiſed, a queſtion will occur, Is the promiſer bound to anſwer fully all the expectations to which the different conſtructions of his words may have given birth? Should I, for inſtance, deſire a man to run with a letter to ſuch a place, and engage to ſatisfy him upon his return; and if on his return I gave him double of the uſual hire in like caſes; but if he be not ſatisfied with leſs than the triple of ſuch a ſum, am I obliged to grant his demands? This will lead us to conſider the rules by which a promiſe ſhould be interpreted.

4 Whether the meaning of the promiſer or promiſee ought to be taken.

If a promiſe were always to be deemed obligatory in the ſenſe in which the promiſee receives it, a man would not know what he had promiſed; the promiſee, from a difference of views, aſſociations, and intereſts, might conceive a ſenſe of which the promiſer had never dreamed; might ſuppoſe engagements which were never intended, which could not be foreſeen, and, although foreſeen, could not be performed. For theſe reaſons it is natural to think that the ſenſe of the promiſer ſhould rather direct the interpretation. He knows preciſely what it is he has undertaken, and is unqueſtionably the beſt judge of what meaning he affixed to his words. His explanation ſhould therefore be admitted, if information alone could give him a title to decide in the affair.

But ſomething more than mere information, or a knowledge of the cauſe, is expected from a judge, as integrity is equally eſſential to his character. Doubts may ariſe when the words will admit of various meanings, whether the promiſer will be ſo candid as impartially to own the preciſe meaning which he had actually annexed to his expreſſions: At any rate, if he wiſhed to deceive, he might purpoſely uſe an ambiguous phraſeology, and perform the promiſe in a ſenſe of his own without ſatiſfying the reaſonable hopes of the promiſee.

When the daughter of Tarpeius bargained with Tatius to betray the citadel for what he and his Sabines wore on their left hands, meaning their rings and their golden bracelets, Tatius probably performed his promiſe in the way which he intended, when he cauſed her to be buried under their ſhields, which they carried alſo on their left hands. But who will ſay that here was not treachery and a diſhonourable abuſe of that confidence which had been repoſed in him?

5 In doubtful caſes the interpretation of neither is to be truſted.

It muſt therefore be obvious, that the import of a promiſe, where its meaning is diſputed, is not to be determined by the ſenſe of the promiſer nor by the expectations of the promiſee; and if it was ſaid that the obligation of a promiſe aroſe from thoſe expectations which had been raiſed by it, the aſſertion now muſt be limited to thoſe expectations which were intentionally raiſed by the promiſer, or thoſe which to his knowledge the promiſee was induced to entertain in conſequence of that declaration which had been made to him. Should there ſtill be a doubt about what expectations were intentionally raiſed, and what ſhould have been reaſonably entertained, recourſe muſt be had to the judgment of thoſe who are allowed to be perſons of candour, and who are acquainted with the characters of the men, and with thoſe circumſtances in which the promiſe was made.

6 Caſes where a promiſe is not binding.

The following are ſome of the caſes in which a promiſe is not binding. As the obligation to perform the promiſe ariſes from thoſe expectations which are intentionally raiſed by the promiſer; it is plain that no promiſe can be binding before acceptance, before the promiſe has been communicated to the promiſee, and before he has entertained hopes of its performance. The caſe is ſimilar where a promiſe is releaſed, that is, where the performance is diſpenſed with by the promiſee, and where he entertains no expectations on account of any thing that the promiſer has ſaid to him. Should a third perſon entertain hopes on account of the promiſe, he is to cheriſh theſe hopes at his own hazard, having no encouragement from the promiſer to do ſo: yet if this perſon has been warranted to hope by the promiſee, the promiſee has renounced his privilege of releaſing the promiſe, and along with the promiſer becomes bound for its performance.

7 When it is releaſed by the promiſee.

8 Where its performance is unlawful.

A promiſe is not binding where the performance is unlawful; and the performance is unlawful where it is contrary to former promiſes, or to any moral and religious precept, which from the beginning to the end of time is of perpetual and unalterable obligation. Thus no man is bound by his promiſe to give to me what he has already promiſed to another; and no man is bound by his promiſe to blaſpheme God, to commit murder, or to criminate the innocent. Such promiſes are unlawfully made, and cannot be otherwiſe than unlawfully performed.

9 A caſe where doubts have ariſen.

Some have even carried their ſcruples ſo far as to doubt, whether any promiſe, unlawfully made, can be lawfully performed. Should a man, during the lifetime of his wife, happen to promiſe marriage to another, ſuch a man (they ſay) by the Chriſtian religion has already committed adultery in his heart; and ſhould he afterwards become a widower, he is not bound, and he even ought not, to fulfil his engagements, as this would be putting his criminal intention into execution. This ſpecies of reaſoning, we muſt confeſs, is to us unintelligible. —As the wife is dead, what now ſhould prevent the man from marrying the object of his affections? Why, ſay the caſuiſts, he already is under a promiſe to marry her, and his promiſe was made at a time when it ſhould not have been made. It is true, the performance, conſidered by itſelf, is oppoſed by no law human or divine; but then it originated in what was wrong; and however much the Supreme Being and the bulk of the creation may be out of the ſecret, we have diſcovered by the ingenious logic of caſuiſtry, that evil can never ſpring out of good, nor good out of evil; but that the means and the end, the motive and the action are always of the ſame complexion in morals.

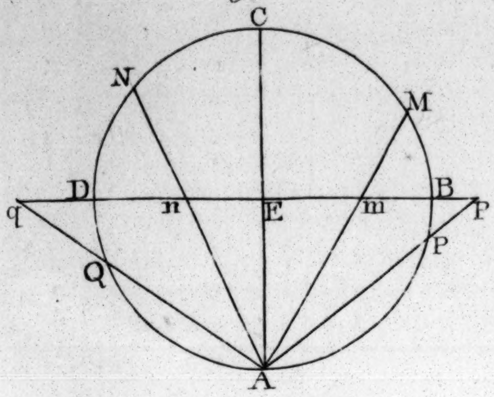
10 Erroneous promiſes.

When a promiſe is made, the particular circumſtances in which it is to be deemed obligatory are ſometimes mentioned. "I promiſe (for inſtance) to lend my friend 200 pounds within three days, provided a certain creditor which I name do not make a demand on me before that time." In other caſes no circumſtance is foreſeen by the promiſer to prevent the fulfilling of his engagement; and hence we have erroneous promiſes, which proceed on the ſuppoſition that things are true, poſſible, and lawful, which are not ſo. An erroneous promiſe, which proceeds on the falſe repreſentation of the promiſee, is not binding.

A London gentleman lately purchaſed an eſtate in the ſouth of England at a public ſale, believing the deſcription which he ſaw in the newſpapers, and which likewiſe was given by the auctioneer, to be true; but finding afterwards that the eſtate nowiſe correſponded to the deſcription, the law freed him from his engagement, becauſe the ſeller had evidently been guilty of

PROJECTION of the SPHERE. Plate CCCCXIX.

Fig. 1.


C
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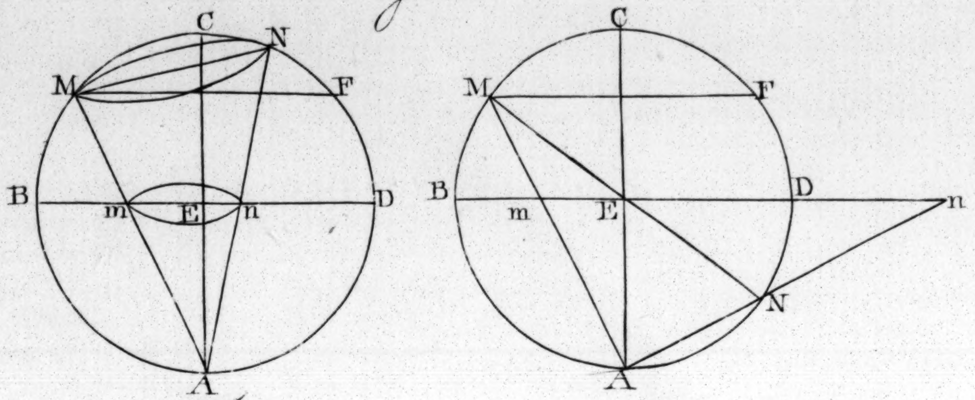
M
D
B
q
n
E
m
p
P
Q
A

Fig. 2.


C
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C
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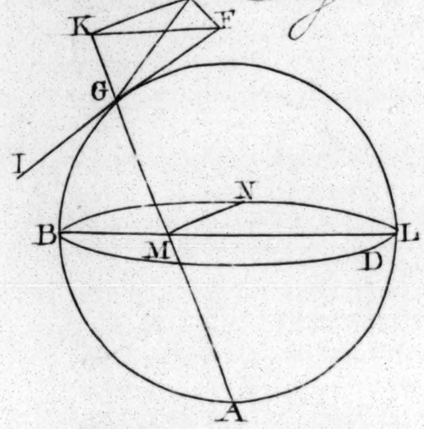
Fig. 3.


R
K
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D
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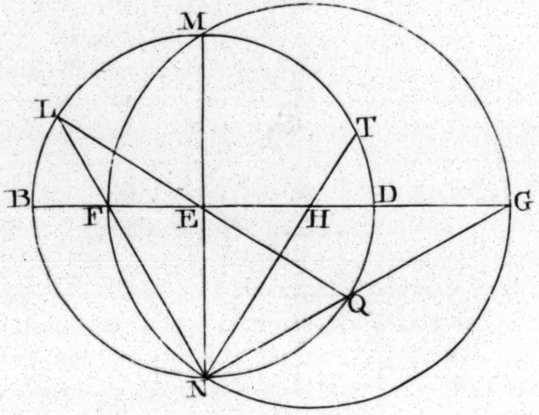
Fig. 4.


M
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Q
N

Fig. 5.

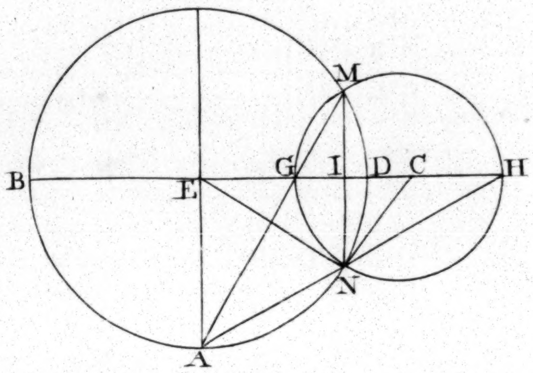

M
B
E
G
I
D
C
H
N
A

Fig. 6.

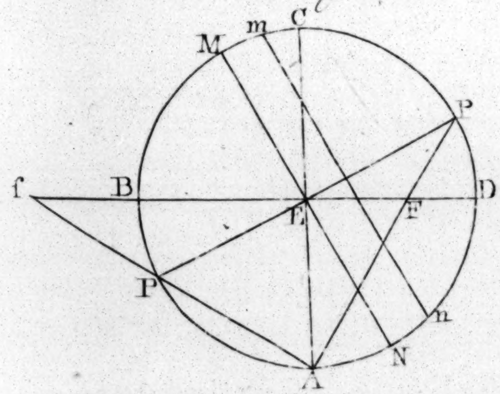

M
m
C
P
f
B
E
F
D
P
n
A
N

Fig. 7.

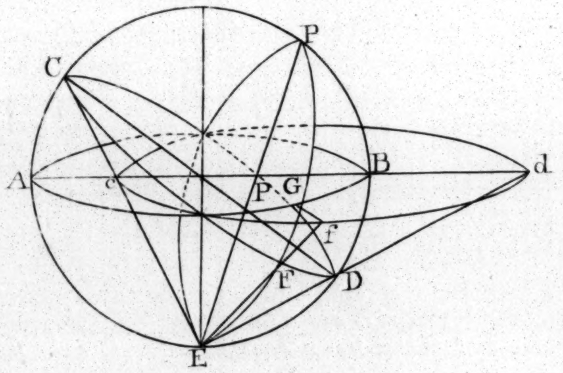

C
P
A
c
B
d
P
G
f
F
D
E

Fig. 8.

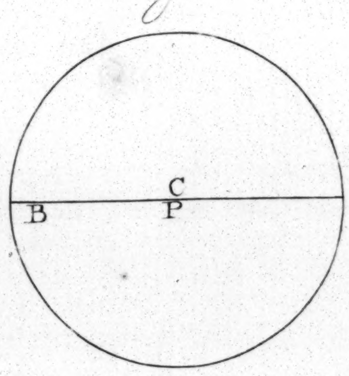


Fig. 9.

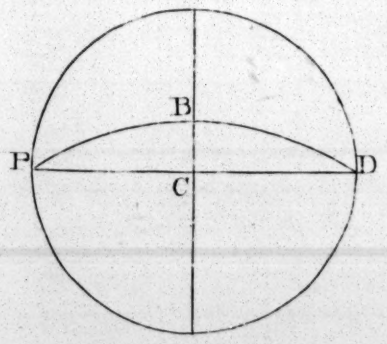


Fig. 10.

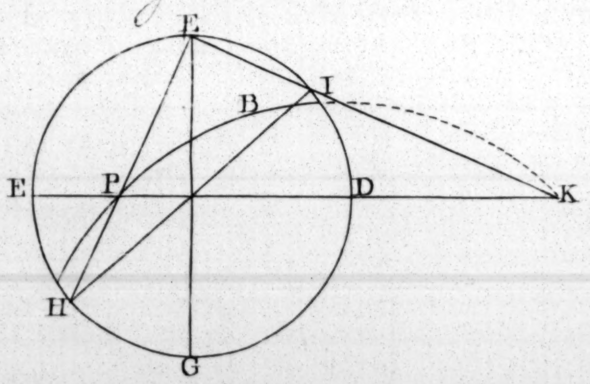
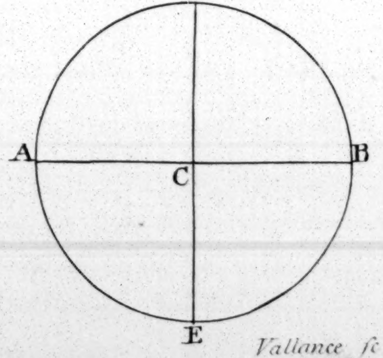


Fig. 11.



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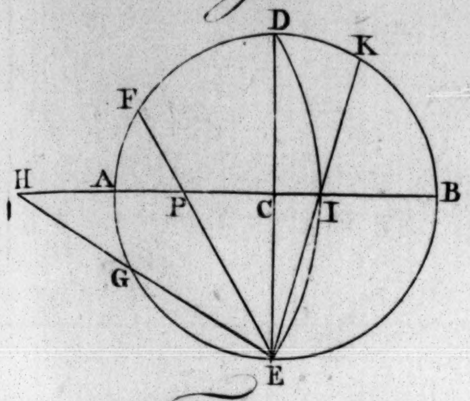
PROJECTION of the SPHERE Plate CCCCXX

Fig. 12.


D
K
F
H
A
P
C
I
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E

Fig. 13.

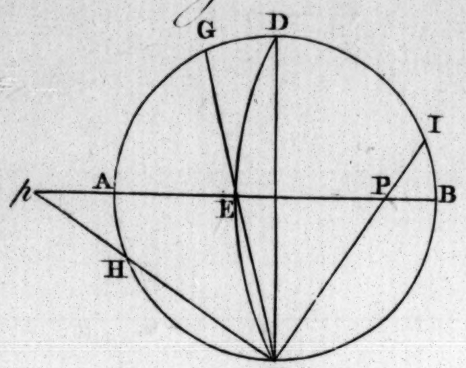

G
D
I
p
A
E
P
B
H
F

Fig. 14.

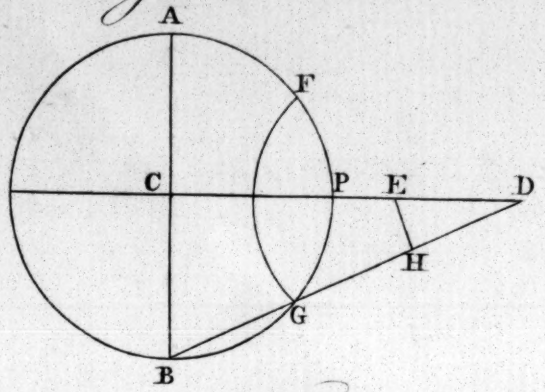


Fig. 15.

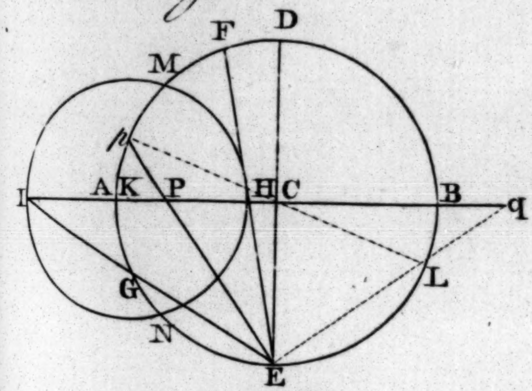
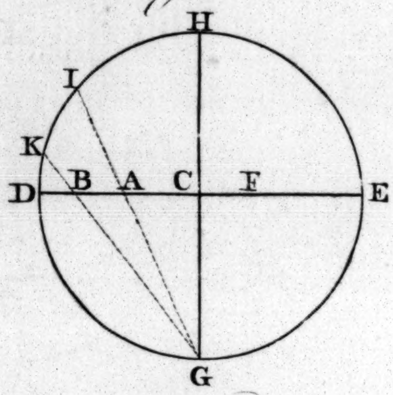

F
D
M
p
I
A
K
P
H
C
B
q
G
L
N
E

Fig. 16.


H
I
K
D
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A
C
F
E
G

Fig. 17.

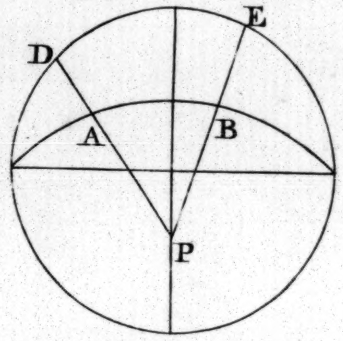


Fig. 18.

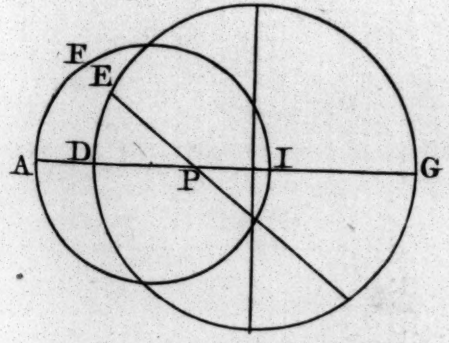


Fig. 19.

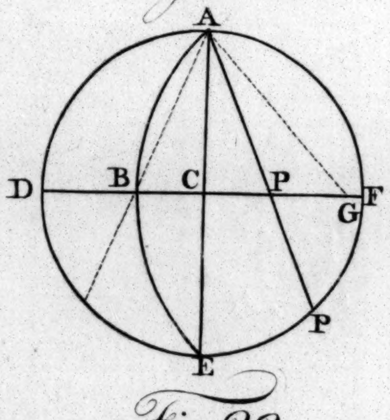
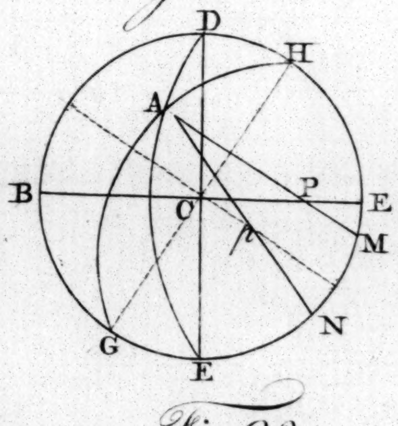


Fig. 20.


D
H
A
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C
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E
p
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N
E

Fig. 21.

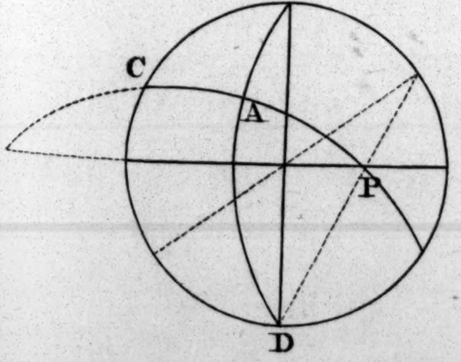
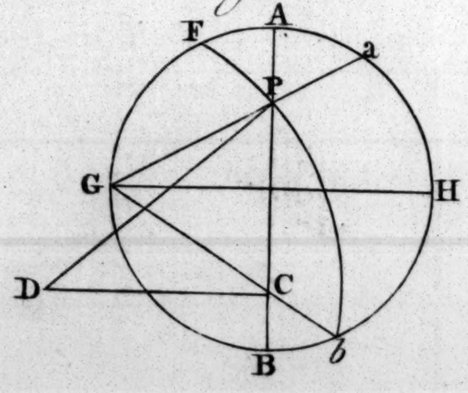


Fig. 22.


F
A
a
P
G
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D
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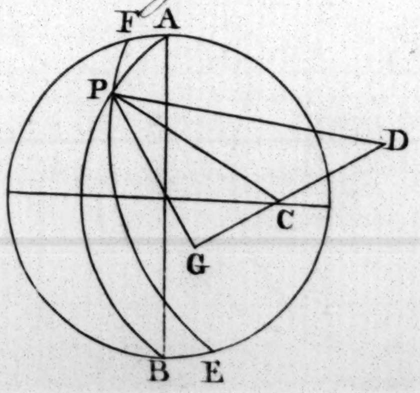
B
b

Fig. 23.

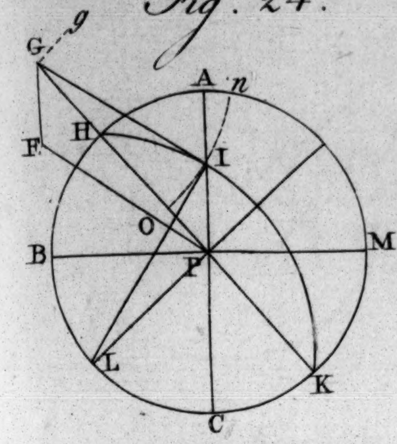


Thackara sc

BRITISH MUSEUM

PROJECTION of the SPHERE Plate CCCCXXI

Fig. 24.



G
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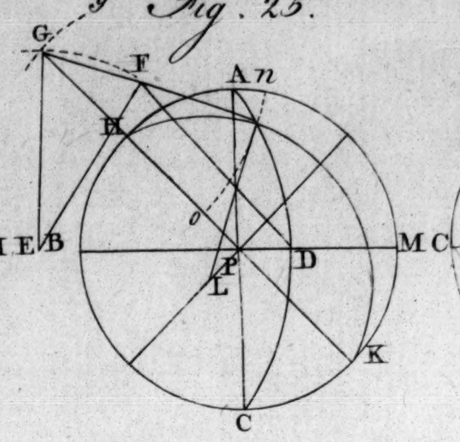
C

Fig. 25.



g
G
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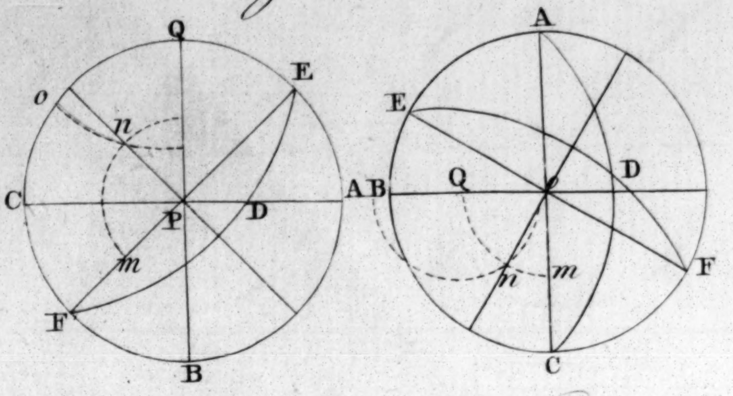
Fig. 26.



Q
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D
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F
B
A
E
B
Q
D
n
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F
C

Fig. 27.

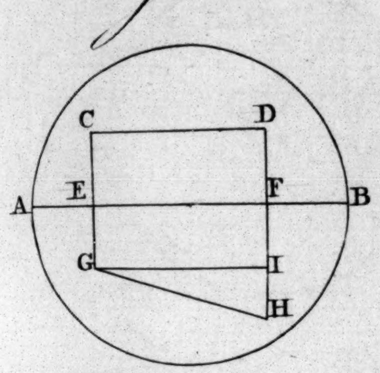


Fig. 28.

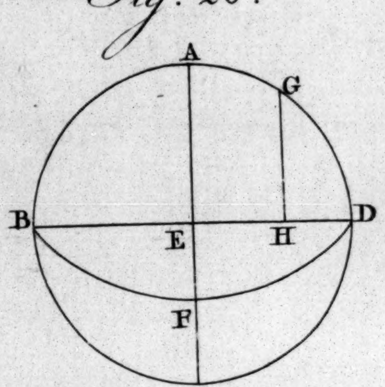
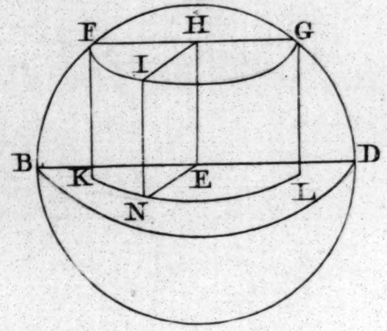


Fig. 29.



A
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Fig. 30.

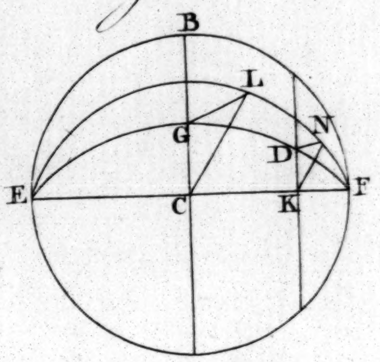
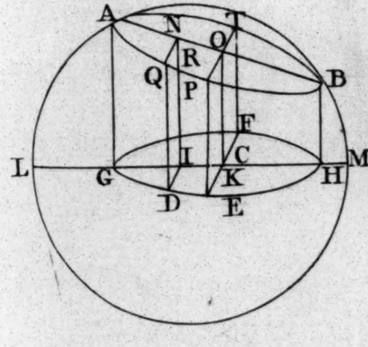


Fig. 31.



A
N
T
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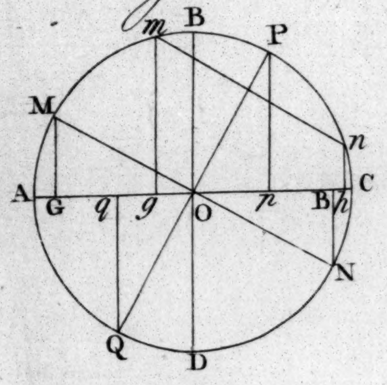
Fig. 32.



m
B
P
M
n
A
G
q
g
O
p
B
h
C
N
Q
D

Fig. 33.

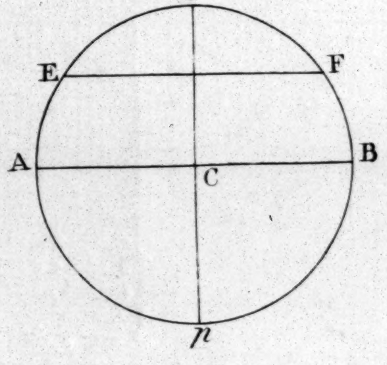
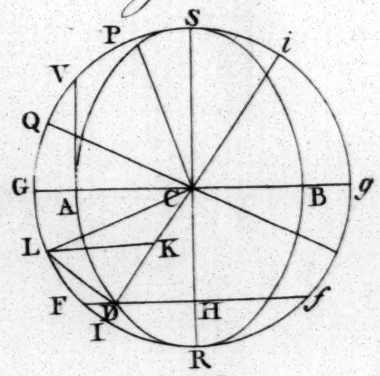
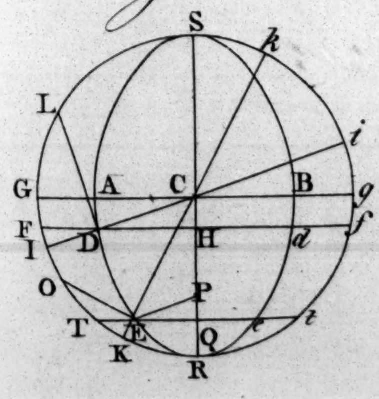


Fig. 34.



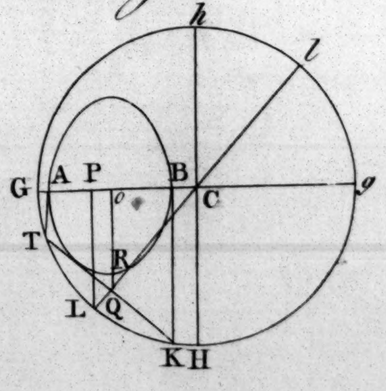
P
S
i
V
Q
G
C
B
g
A
L
K
F
D
H
f
I
R

Fig. 35.



S
k
L
i
G
A
C
B
g
F
I
D
H
d
f
O
P
T
E
e
t
K
Q
R

Fig. 36.



h
l
G
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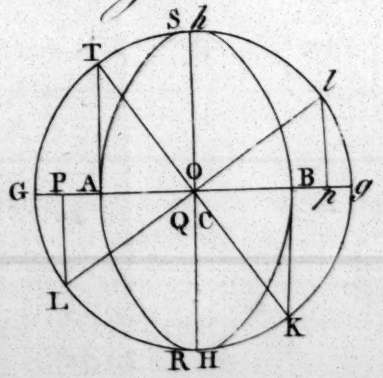
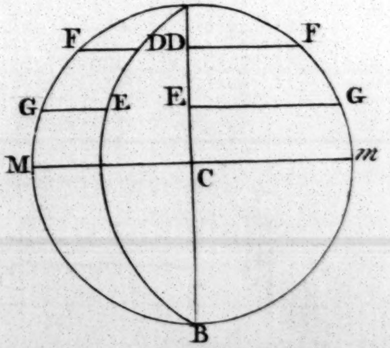
P
B
o
C
g
T
R
L
Q
K
H

Fig. 37.



S
h
T
l
G
P
A
O
B
p
g
Q
C
L
K
R
H

Fig. 38.



A
F
DD
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G
E
E
G
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C
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B

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BRITISH MUSEUM

PROJECTION of the SPHERE.

Plate CCCCXXII.

Fig. 39.

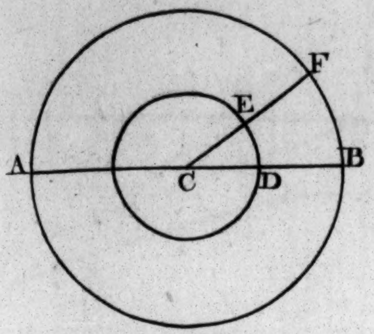
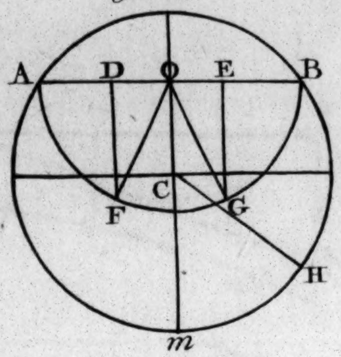


Fig. 40.


A
D
O
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B
C
F
G
H
m

Fig. 41.

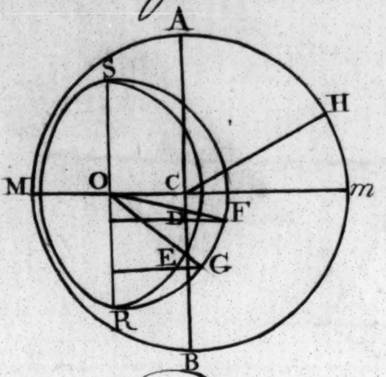

A
S
H
M
O
C
m
D
F
E
G
R
B

Fig. 42.

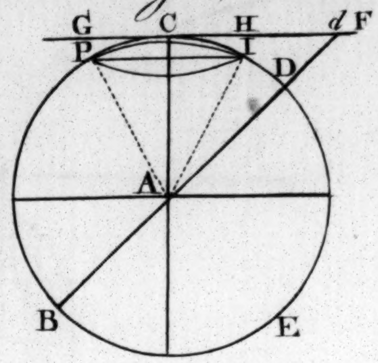

G
C
H
d
F
P
I
D
A
B
E

Fig. 43.

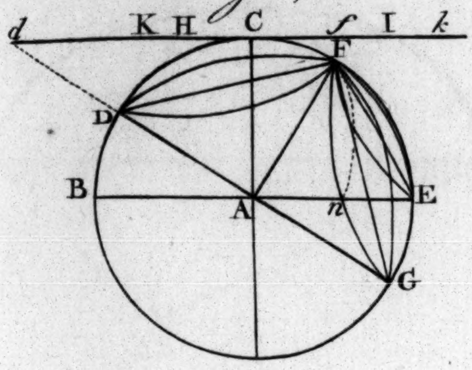
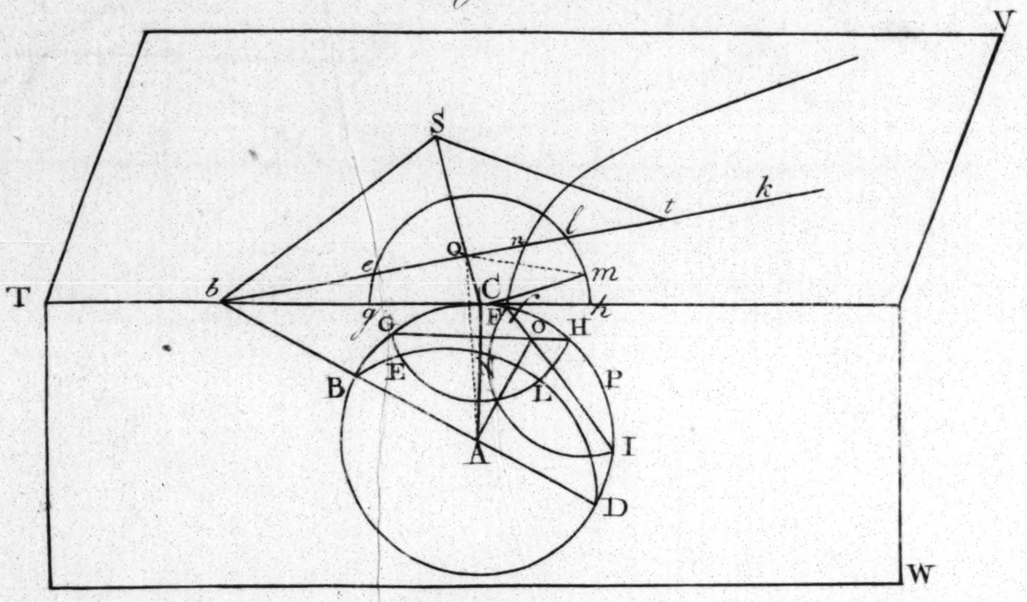

d
K
H
C
f
I
k
F
D
B
A
n
E
G

Fig. 44.


V
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t
k
l
n
Q
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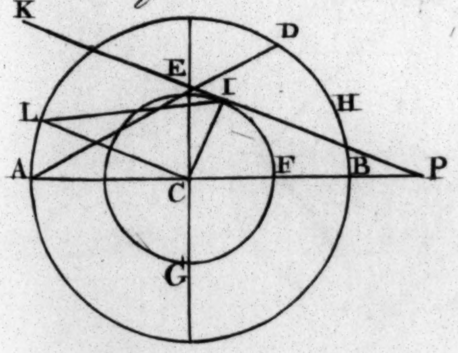
b
T
C
g
G
F
o
H
h
B
E
N
L
P
A
I
D
W

Fig. 46.


K
D
E
I
H
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A
C
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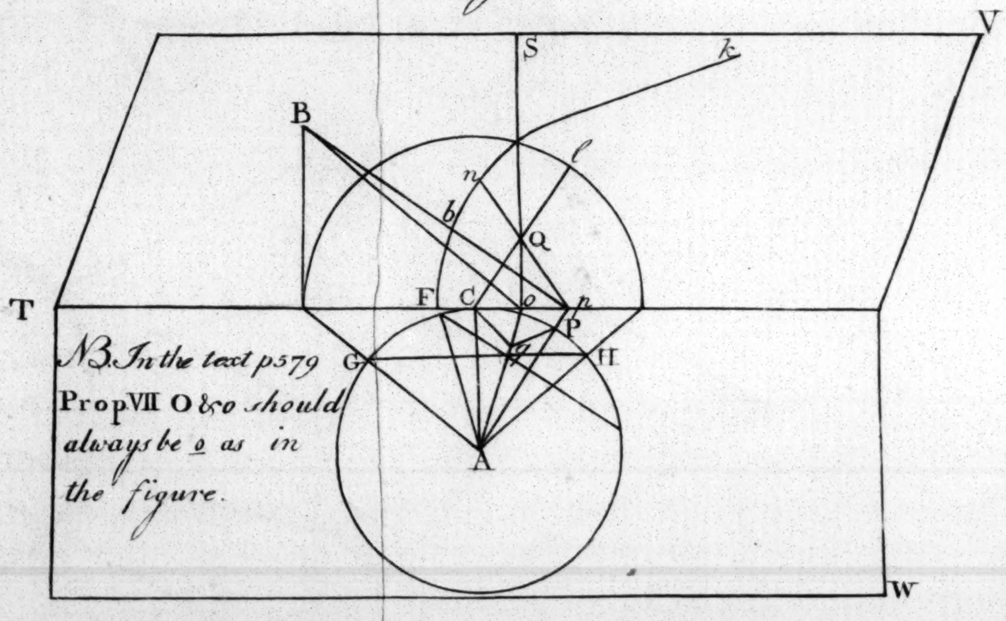
G

Fig. 45.


S
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k
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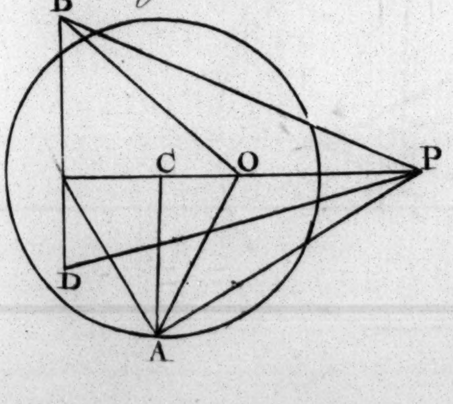
H
A
W

N.B. In the text p579
Prop VII O & o *should*
always be o *as in*
the figure.

Fig. 47.



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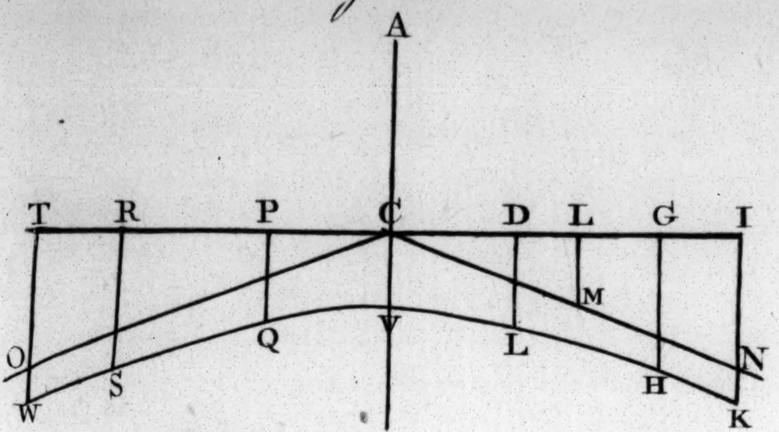
PROJECTION of the SPHERE. Plate CCCCXXIII.

Fig. 48.


A
T
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C
D
L
G
I
M
O
Q
V
L
N
W
S
H
K

Fig. 49.

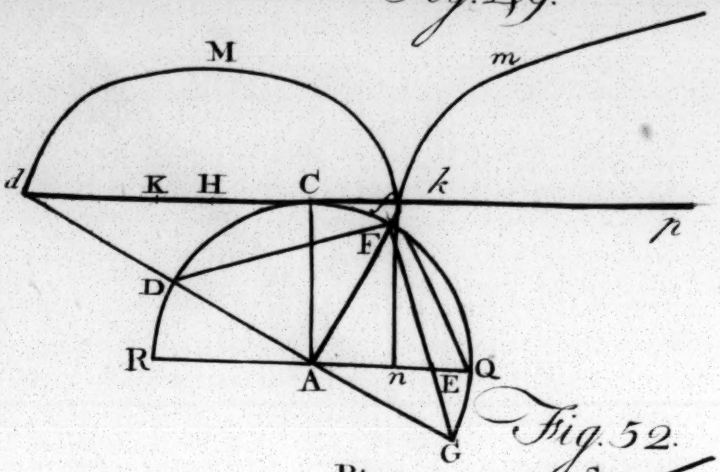

M
m
d
K
H
C
k
p
F
D
R
A
n
E
Q
G

Fig. 50.

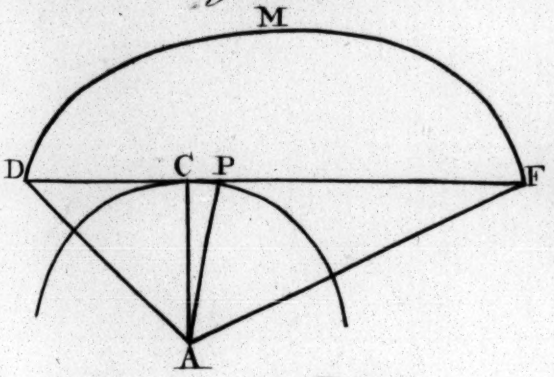


Fig. 51.

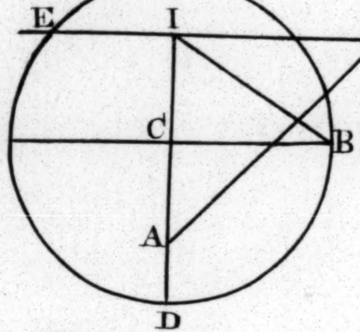
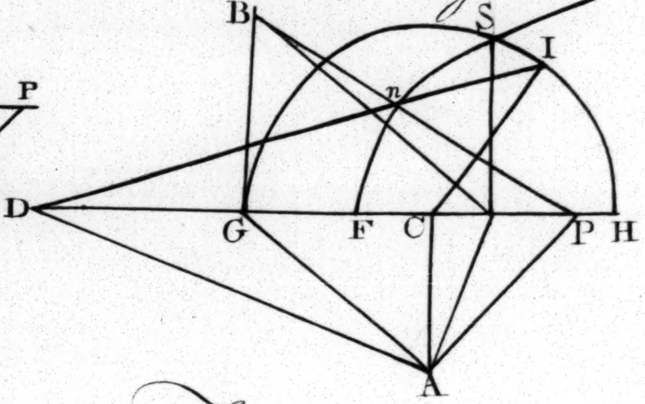


Fig. 52.


B
S
I
n
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G
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P
H
A

Fig. 53.

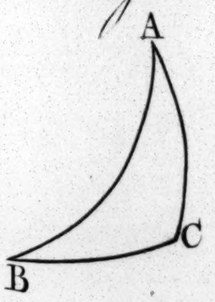


Fig. 54.

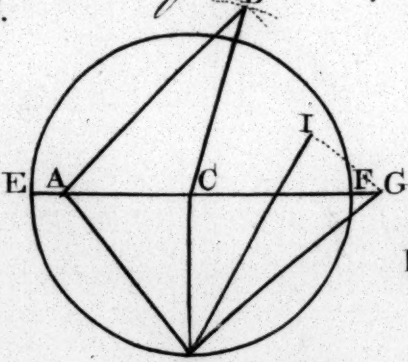


Fig. 55.

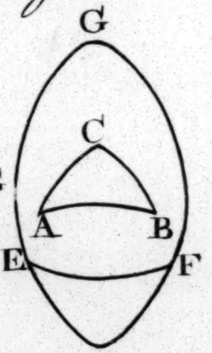
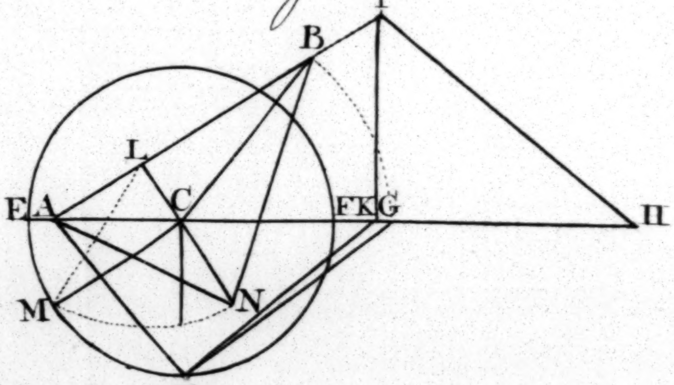


Fig. 56.


I
B
L
E
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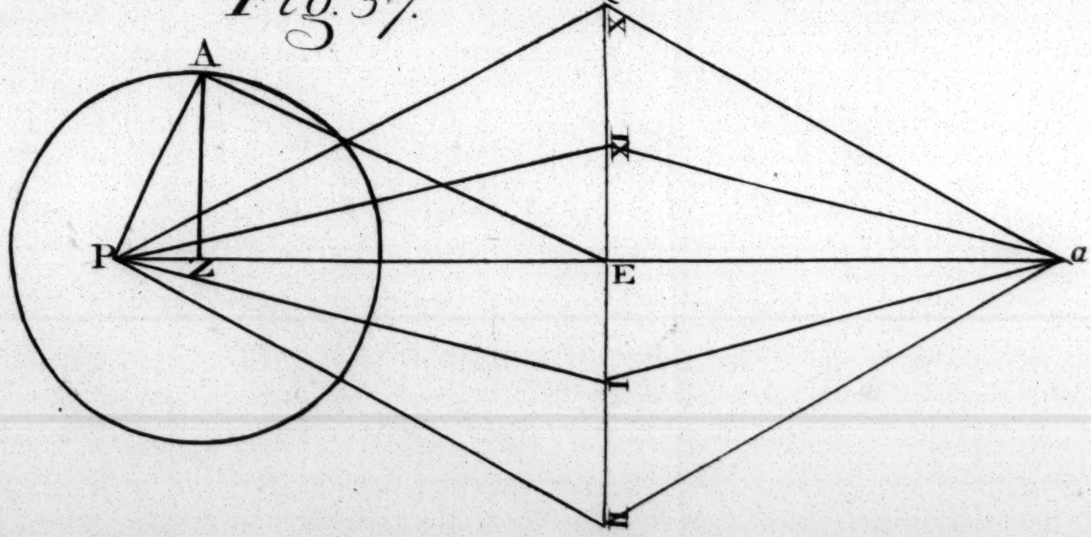
G
H
M
N
D

Fig. 57.



BRITISH MUSEUM

a breach of promiſe in not ſatisfying thoſe expectations which he had intentionally and even ſtudiouſly excited in the buyers.

11 A promiſe not binding when the performance is impoſſible,

An erroneous promiſe, whoſe performance is impoſſible, is not binding. Before the concluſion of the late war a planter of Tobago promiſed to ſend to his friend in England 12 hogſheads of ſugar from the next year's produce of his eſtate; but before that time Tobago fell into the hands of the French, and the Weſt Indian found it impoſſible to anſwer the expectations of his friend in England.

12 Nor when it is unlawful.

An erroneous promiſe, whoſe performance is unlawful, or, to ſpeak more preciſely, whoſe performance is contrary to a prior promiſe, or to any moral or religious obligation, is not binding. A father believing the accounts from abroad of his ſon's death, ſoon after bequeathes his fortune to his nephew: but the ſon, the report of whoſe death had been falſe, returns home, and the father is releaſed from the promiſe to his nephew, becauſe it was contrary to a prior promiſe, which he had tacitly come under to his ſon. This prior promiſe was implied in the whole of the father's conduct, and was expreſſed in ſigns as emphatic and as unequivocal as thoſe of language. It had all the effect too of the moſt ſolemn promiſe on the ſon, who, to his father's knowledge, was induced in conſequence of this promiſe to entertain the moſt ſanguine hopes of ſucceeding to his father, if he ſurvived. The world likewiſe could bear teſtimony that theſe expectations were not raſhly cheriſhed. He was brought into exiſtence by means of his father, who was thereby underſtood to love him affectionately; he was uſhered into ſociety as the repreſentative of his family, and was therefore ſuppoſed to be the heir of its wealth. Religion itſelf ſupported his pretenſions, pronouncing the father worſe than an infidel who neglects to ſhow that attention to his children which the world naturally expects from a parent.—That the father's promiſe was not releaſed from the mere circumſtance that the miſtake was known to his nephew the promiſee, will appear plain from the following circumſtance. Suppoſe the father a landed proprietor, that the leaſe of one of his farms has expired, and that he has long been expecting to let it at L. 200; ſuppoſe that this ſum is refuſed, and that he agrees with the preſent tenant to grant a new leaſe at L. 150—the obligation here to perform his promiſe is not diſſolved by an after offer of L. 200, though the tenant knew that L. 200 had been expected, and that only from deſpairing of that ſum his landlord had granted the new leaſe at L. 150: the promiſe is binding, becauſe the performance is every way lawful, contrary to no prior engagement, and oppoſed to no principle in morals. The law of the land, were the proprietor reluctant, would enforce the obligation, and exact obedience in the tone of authority; becauſe breaches of faith, were they permitted in ſuch caſes, would deſtroy all confidence, and annihilate the bonds of ſocial union:

> Men live and proſper but in mutual truſt;
> A confidence of one another's truth. *Oroonoko.*

13 ility no erion ereby to ge of validity romiſes.

The great difficulty which many have to encounter in determining when erroneous promiſes ought or ought not to be kept, ariſes from their proceeding on a principle of whoſe conſequences they do not ſeem to be always aware. There is ſeldom, they perceive, a virtuous action that is not attended with ſome happy effects; and it will, perhaps, be generally allowed, that the comparative merit of ſimilar virtues may ſafely be eſtimated by their utility: But to make utility, as ſome do, the criterion of virtue, and pronounce an action vicious or virtuous merely on account of thoſe conſequences which they ſee may flow from it, is a dangerous maxim. Evil has often ſprung out of good, and good out of evil; and good and evil have frequently ſprung from the ſame action. In Mandeville's *Hive*,

14 This principle would give a ſanction to vice and falſehood.

> That root of evil Avarice,
> That damn'd ill-natur'd baneful vice,
> Was ſlave to Prodigality,
> That noble ſin; whilſt Luxury
> Employ'd a million of the poor,
> And odious Pride a million more.
> Envy itſelf and Vanity
> Were miniſters of Induſtry:
> That darling folly, Fickleneſs,
> In diet, furniture, and dreſs,
> That ſtrange ridiculous vice, was made
> The very wheel that turn'd the trade.

The deſcription here is not altogether falſe; and theſe indeed may be ſome of the conſequences that flow from avarice, luxury, pride, vanity, and envy: but theſe are not all.—To ſee at once all the conſequences that ſpring from an action, the good and the bad, the particular and general, the immediate and remote, would require ſometimes the foreſight of Omniſcience, and at all times a knowledge ſuperior to what is human. In the Fable, of the Bees, the author's object was to ſhow that private vices are public benefits; and he therefore was naturally led by his argument to conſider only ſuch conſequences of vice as favoured his hypotheſis. He wanted candour. And that artifice which runs through his Fable happens to remind us, that while the remote and the general effects of an action may not be ſeen, the particular and immediate, which fall within our notice, are apt to be viewed through the medium of paſſion, intereſt, or opinion. For theſe reaſons, it appears ſurpriſing how any perſon ſhould ever imagine that the obligation to perform a promiſe ſhould depend entirely upon the ideas which the promiſer apprehended of its utility.

The beſt refutation of ſuch an opinion are the ſingular concluſions to which it leads.

15 The conſequences that flow from it ridiculous and abſurd.

A late writer on political juſtice, who appears to have embraced it, gets into reaſoning not very common. In a part of his ſyſtem he looks on morals as an article of trade: virtue and vice, in his Chapter of *Promiſes*, are but antiquated terms for profit and loſs; and right and wrong are uſed to expreſs what is beneficial and what is hurtful, in his apprehenſion, to himſelf and the community.—With reſpect to veracity, thoſe "rational and intelligent beings," by whom he wiſhes the affairs of the world to be carried on, may, while they act as rational and intelligent, break or perform their promiſes at pleaſure. He thinks it "eſſential to various circumſtances of human intercourſe, that we ſhould be known to beſtow a ſteady attention upon the quantities of convenience or inconvenience, of good or evil, that might ariſe to others from our conduct." After this attention, the diſappointment of the promiſee is not to be minded, though the expectations excited by theſe "rational and intelligent beings" may have "altered the nature of his ſituation, and engaged him in undertakings from which he would otherwiſe have abſtained." What the promiſer takes to be the general utility and the fitneſs of things is to be his guide. And a breach of promiſe will be attended with the following advantages: "The promiſee, and all other men, will be taught to depend more upon their own exertions, and leſs upon the aſſiſtance of others, which caprice may refuſe or juſtice with-hold. He and all others will be taught to acquire ſuch merit, and to engage in ſuch purſuits, as ſhall oblige any honeſt man to come to their ſuccour if they ſhould ſtand in need of aſſiſtance." This breach of promiſe, with a view to the general utility, will, ſo far from being criminal, form a part of that reſolute execution of juſtice which would in a thouſand ways increaſe the independence, the energies, and the virtue of mankind*."

16
A private individual has no right to intrude his ſchemes of utility on the public.

Such are the views which determined this author to conſider "the validity of promiſes" as "inconſiſtent with juſtice," and as "foreign to general good." From one, however, who relies with ſo much confidence on the promiſer, it would be certainly deſirable to know, whether the perſon, who violates his faith for the public utility, is always to be candid. Where breach of faith promotes his own intereſt, ought he alone to decide on the validity of his promiſe? or where promiſes are broken for the general good, is he to be guided by his own viſionary ſchemes of utility? Is he to act as truſtee for the public without any delegated power? and ſhall the community ſubmit to his deciſions without ſo much as putting the queſtion, Who hath made thee a ruler over us? When a writer thus deviates ſo far from the path of reaſon, it is natural to aſk, what was the *ignus fatuus* that miſled him? In the preſent caſe it is pretty obvious. Being ſomething of opinion with the celebrated Turgot*, that romances are the only books in which moral principles are treated in an impartial manner, this gentleman, in his Chapter of *Promiſes*, ſeems to have borrowed a part of his morality from the doggerels of Butler; and having adopted though from different motives, the political principles of Sir Hudibras's ſquire, that obedience to civil government is not due becauſe it is promiſed, he has come to exactly the ſame concluſion with reſpect to the obligation of keeping one's word. But Ralph has reaſoned with more ingenuity; and has ſhown not only that the public good, but the glory of the Lord, may be ſometimes promoted by a breach of faith.

> The ſaints, * whom oaths and vows oblige,
> Know little of their privilege;
> Farther, I mean, than carrying on
> Some ſelf-advantage of their own:
> For if the dev'l, to ſerve his turn,
> Can tell truth, why the ſaints ſhould ſcorn,
> When it ſerves theirs, to ſwear and lie,
> I think there's little reaſon why:
> Elſe h' has a greater pow'r than they,
> Which 'twere impiety to ſay:
> W' are not commanded to forbear,
> Indefinitely, at all to ſwear;
> But to ſwear idly, and in vain,
> Without ſelf-intereſt and gain;
> For breaking of an oath and lying
> Is but a kind of ſelf-denying,
> A ſaint-like virtue; and from hence
> Some have broke oaths by Providence:
> Some, to the glory of the Lord,
> Perjur'd themſelves and broke their word:——
> For ſaints may do the ſame thing by
> The ſpirit, in ſincerity.
> Which other men are tempted to,
> And at the devil's inſtance do.
>
> HUDIBRAS, *Cant.* II.

Here are new views of utility; which, were they to be conſidered as of any weight, would increaſe the difficulty of determining when an erroneous promiſe ought to be kept.

17
Views of utility an unſafe guide in morals.

But ſhould views of utility be laid aſide, and ſhould it be made an invariable rule that truth is on no account to be violated, that deceit is never to be practiſed, and that moral obligations are not to be diſſolved for the proſpect of any phyſical advantage; thoſe doubts which ariſe concerning the validity of erroneous promiſes will ſoon diſappear. Diſagreeable perhaps and ridiculous conſequences may ſometimes ariſe to a few individuals from an honeſt and conſcientious adherence to their promiſe; but will any aſſert that the general good, *that burden of the ſong*, will ever be endangered by too much veracity?

So numerous inconveniences ariſe daily from the regular operation of thoſe great phyſical laws, which are under the immediate direction of Providence, that thoſe philoſophers who have adopted the principle of utility, and are much ſurpriſed to ſee the univerſe ſo aukwardly planned for the eaſe and comfort of them and their ſpecies, have been under the neceſſity of imputing many events in nature to the malignity of ſome evil independent being; or of allowing that things have degenerated ſince they firſt came from the hands of the Creator, and that they muſt now be exceedingly altered from what they had been when He choſe to pronounce them all very good. Thus, abſurdity or impiety muſt always be the conſequence of judging of the vice and virtue of an action by its utility, and of eſtimating its utility by our limited views and erroneous conceptions.

18
Extorted promiſe

19
Whethe binding not.

As for extorted promiſes, it is curious to obſerve how this queſtion ſhould always be ſtarted, whether or not they ought to be kept? and another queſtion ſhould ſeldom be thought of, whether or not they ought to be made? Fortitude was one of the cardinal virtues among the ancients; and is deemed of ſuch importance in the Chriſtian ſyſtem, that the fearful are claſſed with the unbelievers, and are thought unworthy of the favour of Deity, as being incapable of ſupporting thoſe trials to which heaven expoſes the faithful as the trueſt teſt of Chriſtian virtue.—If a perſon ſhould want the neceſſary fortitude to be virtuous, it will be a poor excuſe for his baſeneſs, that he has added deceit to his cowardice: and ſurely it is not the buſineſs of morality, when it has found him guilty of one crime, to grant him a diſpenſation for committing two. The laws of juriſprudence, it will readily be allowed, cannot favour the claims of the promiſee; becauſe they ought never

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* Godwin's Inquiry concerning Political Juſtice, book 3. ch. 3.

* See Note b. iii. ch. 6.

* The ſaints are Godwin's rational and intelligent beings.

to lend their ſupport to oppreſſion and violence. But their acquital, ſhould he violate his faith, will by no means vindicate the character of the promiſer. Their acquitting a woman from the charge of adultery, goes a ſhort way in reſtoring the fair reputation of her innocence.

Let juriſprudence decide as it will, the man of honour and the generous patriot can never be brought to reſpect the perſon who, ſtruck with a panic, could betray either himſelf or his friends. The magnanimous ſpirits who could die for the truth will view with contempt his pitiful deceit. Thoſe unfortunate men who may ſuffer from that very diſtruſt which the breach of his faith has begotten, will always deteſt him as a traitor and enemy; and heaven itſelf cannot be ſuppoſed to reward that ſoldier who deſerts her cauſe, and relinquiſhes the poſt which ſhe has aſſigned him, at the ſight of danger.

If we once begin to accommodate morality to the diſpoſitions and humours of mankind, it is hard to ſay where this ſpecies of complaiſance will end. The degrees of timidity are ſo various, and ſome tempers by nature ſo yielding, that repeated importunity or an earneſt requeſt will extort a promiſe.

20 The laws of morality are not to be accomodated to the humours and intereſts of mankind.

A young lady was frequently preſſed by her dying huſband to grant him a promiſe that ſhe would not marry after his death. For ſome time ſhe was able to reſiſt with becoming ſpirit his abſurd requeſt; but upon his declaring oftener than once that he could not otherwiſe die in peace, ſhe complied and promiſed. Too young, however, for this effort of continence, ſhe afterwards liſtened to the addreſſes of a ſecond lover, and found her heart inſenſibly engaged before ſhe adverted to the impropriety of a new attachment. But propoſals of marriage could ſcarcely fail to remind her of her promiſe and awaken her ſcruples. Theſe ſhe ſoon communicated to her lover, with her firm reſolution to remain a widow, if the contrary meaſure, which ſhe greatly preferred, and on which her earthly happineſs depended, were not approved by ſome ſpiritual counſellor.

Upon this declaration it was agreed to take the advice of their own miniſter, who was an eminent diſſenting clergyman in the dioceſe of Oxford: but this gentleman, unwilling to decide in a matter of ſuch importance, propoſed to refer it to Dr Secker, who was then biſhop of that ſee. This prelate too declined to give any judgment in the caſe; but, as was his way, muſtered up a number of arguments on each ſide of the queſtion, and committed them to a letter, which a learned gentleman of our acquaintance had ſome time ago an opportunity of ſeeing in manuſcript.

If the ſentiments to which the biſhop was inclined could have been inferred from his ſtatement of arguments, he ſeemed to think that the promiſe was binding. In our opinion, he ought to have given a poſitive deciſion. It was no matter whether the promiſe was extorted or not: the promiſe was made; and the queſtion was now, whether or not was the performance lawful? That it was lawful appears evident. The lady was under a moral obligation to remain a widow; and no moral obligation, ſo far as we know, required her to marry.

21 Moral laws ſuperior to phyſical in point of obligation.

To be fruitful and multiply, indeed, is declared in Scripture, and is found, to the woſul experience of many, to be one of the general laws of our nature. But of all theſe laws intended by nature to regulate the conduct of inferior intelligences, the moral, which were meant to be checks and correctors of thoſe abuſes to which the phyſical are apt to be carried, are certainly the moſt ſacred and obligatory. To procreate his ſpecies, a man is not then to be guilty of adultery, nor of fornication, nor to liſten to the lewd calls of incontinency. St Paul's obſervation, that it is better to marry than burn, cannot be allowed in this inſtance to have much weight. He has not defined what degree of amorous inflammation conſtitutes burning, nor in what caſes this burning would be a ſufficient warrant for marrying. In the preſent inſtance he does not even conſider marriage as a duty; he compares it with burning, and thinks it only the leaſt of the two evils. Not that marriage is evil of itſelf; for he that marrieth doth well: but there are circumſtances in which it would be inconvenient to marry, and in which he that marrieth not is ſaid to do better. But if thoſe inconveniences be reaſons ſufficient to deter from marrying, is that perſon to be held excuſable who, in order to gratify an animal paſſion, ſomewhat refined, ſhould violate an oath, and trample on a ſacred moral obligation?

The young lady might indeed declare that her earthly happineſs was at an end if ſhe were not permitted to marry again: but what circumſtance prevented her from marrying? It was not the opinion of her own paſtor, nor the biſhop of Oxford: the truth is, it was certain ſcruples of her own, which being unable of herſelf to overcome, ſhe had piouſly ſolicited the aſſiſtance of others. It is certainly a misfortune that a devotional and amorous turn ſhould always be ſo cloſely connected in the females. Both, however, cannot always be indulged. Who will ſay, that the motive is rational which inclines one to cheriſh a paſſion which conſcience diſapproves? The virtue of continency might indeed have borne hard on this lady's conſtitution, and in her way to immortal happineſs might have formed a gate ſo ſtrait and narrow as it might be difficult for her to paſs through: but after all, her caſe was not harder than that of nuns, who take the vows of perpetual chaſtity, and endure ſufferings of a ſimilar nature, and in ſome inſtances even perhaps greater than hers; yet doing it cheerfully, from the ſuppoſition that the Omniſcient is well acquainted with the nature of the great ſacrifice which they make, and that after death he will ſtudy to requite them, and beſtow on them ſomething like an equivalent, which in their opinion can ſcarcely be leſs than a happineſs in heaven as ample as their wiſhes and as laſting as their ſouls.

Every promiſe, therefore, which is not releaſed, nor fraudently obtained by the promiſee, is to be held binding if the performance be lawful and poſſible.

22 A promiſe of a ſimilar nature with an oath.

The Chriſtian cannot, and a man of honour will ſcarcely venture to reject this maxim, that a good man ought not to change though he ſwear to his hurt. Yet a ſimple promiſe and a promiſſory oath are not very different in point of obligation. Moſt people know, and, where any moral duty is concerned, they ought particularly to reflect, that this world is governed by an Almighty Being, who knows all things, who lives always, and who is juſt to reward and to puniſh. The perſon who makes a promiſſory oath does it avowedly under an immediate ſenſe of theſe truths; the perſon who makes a ſimple promiſe, though he certainly ought, yet may not reflect on theſe at the time. The former, when he violates his oath, exhibits, only to outward appearance, a greater contempt of the Divine power, knowledge, and juſtice, than he who violates a ſimple promiſe under an impreſſion of the ſame truths. To Him who knows the ſecrets of the heart, the breach of the promiſe muſt appear as criminal as the breach of the oath. See ASSUMPSIT and OATH.

PROMONTORY, in geography, a high point of land or rock projecting out into the ſea; the extremity of which towards the ſea is called a *cape* or *headland*. See Plate CCXII.

PROMPTER, in the drama, an officer poſted behind the ſcenes, whoſe buſineſs it is to watch attentively the actors ſpeaking on the ſtage, in order to ſuggeſt and put them forward when at a ſtand, to correct them when amiſs, &c. in their parts.

PROMULGATED, or PROMULGED, ſomething publiſhed or proclaimed, and generally applied to a law, to denote the publiſhing or proclaiming it to the people.

PRONAOS, in the ancient architecture, a porch to a church, palace, or other ſpacious building. See the article PORCH.

PRONATION, among anatomiſts. The radius of the arm has two kinds of motions, the one called *pronation*, the other *ſupination*. Pronation is that whereby the palm of the hand is turned downwards; and ſupination, the oppoſite motion thereto, is that whereby the back of the hand is turned downwards. The peculiar muſcles whereby pronation is performed, are called *pronatores*, as thoſe by which ſupination is performed are termed *ſupinatores*. See ANATOMY, *Table of the Muſcles*, and *Plates*.

PRONG-HOE, in huſbandry, a term uſed to expreſs an inſtrument uſed to hoe or break the ground near and among the roots of plants.

The ordinary contrivance of the hoe is very defective, it being only made for ſcraping on the ſurface; but the great uſe of hoeing being to break and open the ground, beſide the killing of the weeds, which the ancients, and many among us, have thought the only uſe of the hoe, this dull and blunt inſtrument is by no means calculated for the purpoſes it is to ſerve. The prong-hoe conſiſts of two hooked points of ſix or ſeven inches long, and when ſtruck into the ground will ſtir and remove it the ſame depth as the plough does, and thus anſwer both the ends of cutting up the weeds and opening the land. It is uſeful even in the horſe-hoeing huſbandry, becauſe the hoe-plough can only come within three or four inches of the rows of the corn, turnips, and the like; whereas this inſtrument may be uſed afterwards, and with it the land may be raiſed and ſtirred even to the very ſtalk of the plant. See AGRICULTURE and HOE.

PRONOUN, PRONOMEN, in grammar, a declinable part of ſpeech, which being put inſtead of a noun, points out ſome perſon or thing. See GRAMMAR.

PRONUNCIATION, in grammar, the manner of articulating or ſounding the words of a language.

Pronunciation makes the moſt difficult part of written grammar; in regard that a book expreſſing itſelf to the eyes, in a matter that wholly concerns the ears, ſeems next akin to that of teaching the blind to diſtinguiſh colours: hence it is that there is no part ſo defective in grammar as that of pronunciation, as the writer has frequently no term whereby to give the reader an idea of the ſound he would expreſs; for want of a proper term, therefore, he ſubſtitutes a vicious and precarious one. To give a juſt idea of the pronunciation of a language, it ſeems neceſſary to fix as nearly as poſſible all the ſeveral ſounds employed in the pronunciation of that language. Cicero tells us, that the pronunciation underwent ſeveral changes among the Romans: and indeed it is more precarious in the living languages, being, as Du Bos tells us, ſubſervient to faſhion in theſe. The French language is clogged with a difficulty in pronunciation from which moſt others are free; and it conſiſts in this, that moſt of their words have two different pronunciations, the one in common proſe, the other in verſe.

As to the pronunciation of the Engliſh language, the ingenious Mr Martin, in his Spelling-Book of Arts and Sciences, lays down the following rules: 1. The final *(e)* lengthens the ſound of the foregoing vowel; as in *can, cane; rob, robe; tun, tune*, &c. 2. The final *(e)*, in words ending in *re*, is ſounded before the *r* like *u*; as *maſſacre, maſſa-cur; lucre, lu-cur*, &c. 3. The Latin dipthongs *æ, œ*, are ſounded like *e*; as *Ætna, Etna; œconomy, economy*, &c.: but at the end of the words *oe*, ſounds like *o*; as in *toe, foe*, &c. 4. Alſo the Engliſh improper diphthongs, *eu, eo, eu, ue*, ſound only the *e* and *u*; as *tea* or *te*; *feoffee* or *feſſe*; *due* or *du*; *true* or *tru*, &c. though ſometimes *eo* and *ea* are pronounced like *ee*, as in *people, fear, near*, &c. 5. Sometimes the diphthong *(ie)* is pronounced like *e* in *cieling*, like *ee* in *field*, and, at the end of words, always like *y*, as in *lie*, &c.; and *ei* is pronounced either like *e* or *ai*, as in *deceit, reign*, &c. 6. The tripthong *eau* is pronounced like *o*, in *beau* and *jet d'eau*; and *ieu* ſounds like *u* in *lieu, adieu*, &c. 7. The ſound of *c* is hard before the vowels *a, o, u*, as in *call, cold, cup*, &c.; alſo ſometimes before *h*, as in *chart, cold*, &c.; and before *l* and *r*, as in *clear, creep*, &c. It is otherwiſe generally ſoft, as in *city, cell, cyder, child*, &c. 8. In French words *ch* is ſounded like *ſh*, as in *chagreen, machine*; and ſometimes like *qu*, as in *choir*. 9. the ſound of *g* is hard before *a, o, u, l, r*, as in *gall, go, gum, glean, grope*; alſo before *ui*, as in *guilt, guild*, &c.; and before *h*, as in *ghoſt*; ſometimes before *i*, as in *gibbous, gibberiſh*. It is alſo generally hard before *e*, as in *get, geld*, &c.; but ſoft in many words derived from the Greek and Latin, as in *geometry, genealogy, genus*, &c. Two *gg* are always hard, as in *dagger*, &c. The ſound of *g*, when ſoft, is like that of *j*. 10. In any part of a word, *ph* ſounds like *f*, as in *philoſophy*, &c. 11. The ſound of *qu*, at the end of French words, is like *k*, as in *riſque*, &c. 12. The ſyllables *ti* and *ci*, if followed by a vowel, ſound like *ſi* or *ſhi*; as in *fiction, logician*, &c. 13. When *cc* occurs before *i*, the firſt is hard and the latter is ſoft; as in *flaccid*, &c. 14. The letter *p* is not pronounced at the beginning of ſyllables before *ſ* and *t*; as in *pſalm, ptarmics*, &c. As to other peculiarities regarding the pronunciation of ſingle letters, many of them have been taken notice of at the beginning of each, in the courſe of this work.

But it is not enough to know the juſt pronunciation of ſingle letters, but alſo of words: in order to which, the accenting of words ought to be well underſtood; ſince nothing is more harſh and diſagreeable to the ears, than to hear a perſon ſpeak or read with wrong accents. And indeed in Engliſh the ſame word is often

Pronunciation, Proof.

Proof.

both a noun and a verb, diſtinguiſhed only by the accent, which is on the firſt ſyllable of the noun, and on the laſt of the verb; as *fèrment* and *fermènt*; *rècord* and *recòrd*, &c. We are to obſerve alſo, that in order to a juſt expreſſion of words, ſome require only a ſingle accent on the ſyllable, as in *tòrment*, &c.; but in others it ſhould be marked double, as in *anȉmal*, becauſe it is pronounced as if the letter was wrote double, viz. *an-nimal*.

Mr Sheridan's Dictionary will be found extremely uſeful as a directory in acquiring the pronunciation of the Engliſh language; but care muſt be taken to avoid his provincial brogue, which has certainly miſled him in ſeveral inſtances. Mr Walker's Pronouncing Dictionary, lately publiſhed, will likewiſe deſerve the ſtudent's attention. It is a work of great labour and merit, and is highly uſeful. It has indeed ſome faults and inaccuracies, but it is notwithſtanding, in all probability, the beſt of the kind.

PRONUNCIATION is alſo uſed for the fifth and laſt part of the rhetoric, which conſiſts in varying and regulating the voice agreeably to the matter and words, ſo as moſt effectually to perſuade and touch the hearers. See ORATORY, Part IV.

PROOF, in law and logic, is that degree of evidence which carries conviction to the mind. It differs from demonſtration, which is applicable only to thoſe truths of which the contrary is inconceivable. It differs likewiſe from probability, which produces for the moſt part nothing more than opinion, while proof produces belief. See PROBABILITY.

The *proof* of crimes was anciently effected among our anceſtors divers ways; viz. by duel or combat, fire, water, &c. See DUEL and ORDEAL.

PROOF of Artillery and ſmall Arms, is a trial whether they ſtand the quantity of powder allotted for that purpoſe. The rule of the board of ordnance is, that all guns, under 24-pounders, be loaded with powder as much as their ſhot weighs; that is, a braſs 24-pounder with 21 lb. a braſs 32-pounder with 26 lb. 12 oz. and a 42-pounder with 31 lb. 8 oz.; the iron 24-pounder with 18 lb. the 32-pounder with 21 lb. 8 oz, and the 42-pounder with 25 lb.

The braſs light field-pieces are proved with powder that weighs half as much as their ſhot, except the 24-pounder, which is loaded with 10 lb only.

Government allows 11 bullets of lead in the pound for the proof of muſkets, and 14.5, or 29 in two pounds, for ſervice; 17 in the pound for the proof of carabines, and 20 for ſervice; 28 in the pound for the proof of piſtols, and 34 for ſervice.

When guns of a new metal, or of lighter conſtruction, are proved; then, beſides the common proof, they are fired 200 or 300 times, as quick as they can be, loaded with the common charge given in actual ſervice. Our light 6-pounders were fired 300 times in 3 hours 27 minutes, loaded with 1 lb. 4 oz. without receiving any damage.

PROOF of Powder, is in order to try its goodneſs and ſtrength. See GUNPOWDER.

PROOF of Cannon, is made to aſcertain their being well caſt, their having no cavities in their metal, and, in a word, their being fit to reſiſt the effort of their charge of powder. In making this proof, the piece is laid upon the ground, ſupported only by a piece of wood in the middle, of about 5 or 6 inches thick, to raiſe the muzzle a little; and then the piece is fired againſt a ſolid butt of earth.

Tools uſed in the PROOF of Cannon are as follow:

Searcher, an iron ſocket with branches, from 4 to 8 in number, bending outwards a little, with ſmall points at their ends: to this ſocket is fixed a wooden handle, from 8 to 12 feet long, and $1\frac{1}{2}$ inch in diameter. This ſearcher is introduced into the gun after each firing, and turned gently round to diſcover the cavities within: if any are found, they are marked on the outſide with chalk; and then the

Searcher with one point is introduced; about which point a mixture of wax and tallow is put, to take the impreſſion of the holes; and if any are found of one-fourth of an inch deep, or of any conſiderable length, the gun is rejected as unſerviceable to the government.

Reliever, is an iron ring fixed to a handle, by means of a ſocket, ſo as to be at right angles; it ſerves to diſengage the firſt ſearcher, when any of its points are retained in a hole, and cannot otherwiſe be got out. When guns are rejected, by the proof-maſters, they order them to be marked X thus, which the contractors generally alter *WP* thus; and after ſuch alteration, diſpoſe of them to foreign powers for Woolwich proof.

The moſt curious inſtrument for finding the principal defects in pieces of artillery, was lately invented by lieutenant-general Deſaguliers, of the royal regiment of artillery. This inſtrument, grounded on the trueſt mechanical principles, is no ſooner introduced into the hollow cylinder of the gun, than it diſcovers its defects, and more particularly that of the piece not being truly bored; which is a very important one, and to which moſt of the diſaſters happening to pieces of artillery are in a great meaſure to be imputed; for, when a gun is not truly bored, the moſt expert artilleriſt will not be able to make a good ſhot.

PROOF of Mortars and Howitzers, is made to aſcertain their being well caſt, and of ſtrength to reſiſt the effort of their charge. For this purpoſe the mortar or howitzer is placed upon the ground, with ſome part of their trunnions or breech ſunk below the ſurface, and reſting on wooden billets, at an elevation of about 70 degrees.

The mirror is generally the only inſtrument to diſcover the defects in mortars and howitzers. In order to uſe it, the ſun muſt ſhine; the breech muſt be placed towards the ſun, and the glaſs over-againſt the mouth of the piece: it illuminates the bore and chamber ſufficiently to diſcover the flaws in it.

PROOF of Foreign Braſs-Artillery. 1ſt, The Pruſſians. Their battering-train and garriſon artillery are proved with a quantity of powder equal to $\frac{1}{2}$ the weight of the ſhot, and fired 75 rounds as faſt as in real ſervice; that is, 2 or 3 rounds in a minute. Their light field-train, from a 12-pounder upwards, are proved with a quantity of powder = 1-3d of the weight of the ſhot, and fired 150 rounds, at 3 or 4 rounds in a minute. From a 12-pounder downwards, are proved with a quantity of powder = 1-5th of the ſhot's weight, and fired 300 rounds, at 5 or 6 rounds each minute, properly ſpunged and loaded. Their mortars are proved with the chambers full of powder, and the ſhells loaded. Three rounds are fired as quick as poſſible.

2d, The Dutch prove all their artillery by firing each piece 5 times; the two firſt rounds with a quantity of powder = 2-3ds of the weight of the ſhot; and the three laſt rounds with a quantity of powder = ½ the weight of the ſhot.

3d, The French the ſame as the Dutch.

Proof, in brandy and other ſpirituous liquors, is a little white lather which appears on the top of the liquor when poured into a glaſs. This lather, as it diminiſhes, forms itſelf into a circle called by the French the *chapelet*, and by the Engliſh the *bead* or *bubble*.

Nichols's Life of Hogarth.

Proofs of Prints, were anciently a few impreſſions taken off in the courſe of an engraver's proceſs. He proved a plate in different ſtates, that he might aſcertain how far his labours had been ſucceſsful, and when they were complete. The excellence of ſuch early impreſſions, worked with care, and under the artiſt's eye, occaſioning them to be greedily ſought after, and liberally paid for, it has been cuſtomary among our modern printſellers to take off a number of them amounting, perhaps to hundreds, from every plate of conſiderable value; and yet their want of rareneſs has by no means abated their price. On retouching a plate, it has been alſo uſual, among the ſame conſcientious fraternity, to cover the inſcription, which was immediately added after the firſt proofs were obtained, with ſlips of paper, that a number of ſecondary proofs might alſo be created.

Proof, in the ſugar trade. See **Sugar**.

Proofs, in printing. See **Printing**, p. 524, col. 2.

PROPAGATION, the act of multiplying the kind. See **Generation**.

Propagation of Plants. The moſt natural and the moſt univerſal way of propagating plants is by ſeeds. See **Plants**, and **Natural History**, p. 654. But they may alſo be propagated by *ſets*, *pieces*, or *cuttings*, taken from the parent plant. Willows are very eaſily propagated by ſets: ſuch as riſe to be conſiderable timber trees being raiſed from ſets 7 or 8 feet long, ſharpened at their larger ends, which are thruſt into the ground by the ſides of ditches, on the banks of rivers, or in any moiſt ſoil. The ſallow trees are raiſed from ſets only 3 feet long. The plane tree, mint, &c. may be propagated in the ſame way. In providing the ſlips, ſprigs, or cuttings, however, care muſt be taken to cut off ſuch branches as have knots or joints 2 or 3 inches beneath them; ſmall top ſprigs of 2 or 3 years growth are the beſt for this operation. Plants are alſo propagated by parting their roots, each part of which, properly managed, ſends out freſh roots. Another mode of propagating plants is by layering or laying the tops of the branches in the ground.

The method of layering is this: Dig a ring-trench round the ſtool, of a depth ſuitable to the nature of the plant; and having pitched upon the ſhoots to be layered, bend them to the bottom of the trench (either with or without plaſhing, as may be found moſt convenient), and there *peg* them faſt; or, putting ſome mould upon them, *tread* them hard enough to prevent their ſpringing up again—fill in the mould—place the top of the layer in an upright poſture, treading the mould hard behind it; and cut it carefully off above the firſt, ſecond, or third eye. Plants are alſo propagated by their bulbs.

The number of vegetables that may be propagated from an individual is very remarkable, eſpecially in the moſt minute plants. The annual product of one ſeed even of the common mallow has been found to be no leſs than 200,000; but it has been ſince proved, by a ſtrict examination into the more minute parts of the vegetable world, that ſo deſpiſed a plant as the common wall moſs produces a much more numerous offſpring. In one of the little heads of this plant there have been counted 13824 ſeeds. Now allotting to a root of this plant eight branches, and to each branch ſix heads, which appears to be a very moderate computation, the produce of one ſeed is 6 × 13824 = 82944; and 8 × 82944, gives 663,552 ſeeds as the annual produce of one ſeed, and that ſo ſmall that 13824 of them are contained in a capſule, whoſe length is but one ninth of an inch, its diameter but one 23d of an inch, and its weight but the 13th part of a grain.

For the propagation or culture of particular plants, ſee **Agriculture**, Part II. ſect. 3. p. 288. and **Husbandry**.

PROPER, ſomething natural and eſſentially belonging to any thing.

PROPERTIUS (Sextus Aurelius), a celebrated Latin poet, born at Mevania, a city of Umbria, now called *Bevagna*, in the duchy of Spoletto. He went to Rome after the death of his father, a Roman knight, who had been put to death by order of Auguſtus, for having followed Antony's party during the triumvirate. Propertius in a ſhort time acquired great reputation by his wit and abilities, and had a conſiderable ſhare in the eſteem of Mæcenas and Cornelius Gallus. He had alſo Ovid, Tibullus, Baſſus, and the other ingenious men of his time, for his friends. He died at Rome 19 B. C. He is printed with almoſt all the editions of Tibullus and Catullus: but the beſt edition of him is that which was given ſeparately by Janus Brouckhuſius at Amſterdam, 1702, in 4to, and again in 1714, 4to. *cum curis ſecundis ejuſdem.* We have four books of his Elegies or Amours with a lady called *Hoſtia*, or *Hoſtilia*, to whom he gave the name of *Cynthia*.

PROPERTY, in a general ſenſe, is a particular virtue or quality which nature has beſtowed on ſome things excluſive of all others: thus, colour is a property of light; extenſion, figure, diviſibility, and impenetrability, are properties of body.

1 Definition.

Property, in law, is deſcribed to be the higheſt right which a perſon has or can have to any thing.

2 The original foundation of the right to property not generally conſidered.

There is nothing which ſo generally ſtrikes the imagination, and engages the affections of mankind, as the right of property; or that ſole and deſpotic dominion which one man claims and exerciſes over certain external things of the world, in total excluſion of the right of any other individual in the univerſe. And yet there are very few that will give themſelves the trouble to conſider the original and foundation of this right. Pleaſed as we are with the poſſeſſion, we ſeem afraid to look back to the means by which it was acquired, as if fearful of ſome defect in our title; or at beſt we reſt ſatisfied with the deciſion of the laws in our favour, without examining the reaſon or authority upon which thoſe laws have been built. We think it enough that our title is derived by the grant of the former proprietor, by deſcent from our anceſtors, or by the laſt will and teſtament of the dying owner: not caring to reflect, that (accurately and ſtrictly ſpeaking) there is no foundation in nature or in natural law, why a ſet of words upon parchment ſhould convey the dominion of land; why the ſon ſhould have a right to exclude his fellow-creatures from a de-a determinate ſpot of ground, becauſe his father had done ſo before him; or why the occupier of a particular field or of a jewel, when lying on his death-bed and no longer able to maintain poſſeſſion, ſhould be entitled to tell the reſt of the world which of them ſhould enjoy it after him. Theſe inquiries, it muſt be owned, would be uſeleſs and even troubleſome in common life. It is well if the maſs of mankind will obey the laws when made, without ſcrutinizing too nicely into the reaſons of making them. But when law is to be conſidered not only as a matter of practice, but alſo as a rational ſcience, it cannot be improper or uſeleſs to examine more deeply the rudiments and grounds of theſe poſitive conſtitutions of ſociety.

3 This right ariſes from a divine grant.

In the beginning of the world, we are informed by holy writ, that the all-bountiful Creator gave to man "dominion over all the earth; and over the fiſh of the "ſea, and over the fowl of the air, and over every living thing that moveth upon the earth." This is the only true and ſolid foundation of man's dominion over external things, whatever airy metaphyſical notions may have been ſtarted by fanciful writers upon this ſubject. The earth, therefore, and all things therein, are the general property of all mankind, excluſive of other beings, from the immediate gift of the Creator. And, while the earth continued thinly inhabited, it is reaſonable to ſuppoſe, that all was in common among them, and that every one took from the public ſtock to his own uſe ſuch things as his immediate neceſſities required.

4 The ſtate of property in the early ages of the world.

Theſe general notions of property were then ſufficient to anſwer all the purpoſes of human life; and might perhaps ſtill have anſwered them, had it been poſſible for mankind to have remained in a ſtate of primæval ſimplicity: as may be collected from the manners of many American nations, when firſt diſcovered by the Europeans; and from the ancient method of living among the firſt Europeans themſelves, if we may credit either the memorials of them preſerved in the golden age of the poets, or the uniform accounts given by hiſtorians of thoſe times wherein *erant omnia communia et indiviſa omnibus, veluti unum cunctis patrimonium eſſet*. Not that this communion of goods ſeems ever to have been applicable, even in the earlieſt ages, to aught but the *ſubſtance* of the thing; nor could it be extended to the *uſe* of it. For, by the law of nature and reaſon, he who firſt began to uſe it, acquired therein a kind of tranſient property, that laſted ſo long as he was uſing it, and no longer: or, to ſpeak with greater preciſion, the *right* of poſſeſſion continued for the ſame time only that the *act* of poſſeſſion laſted. Thus the ground was in common, and no part of it was the permanent property of any man in particular; yet whoever was in the occupation of any determinate ſpot of it, for reſt, for ſhade, or the like, acquired for the time a ſort of ownerſhip, from which it would have been unjuſt, and contrary to the law of nature, to have driven him by force; but the inſtant that he quitted the uſe or occupation of it, another might ſeize it without injuſtice. Thus alſo a vine or other tree might be ſaid to be in common, as all were equally entitled to its produce; and yet any private individual might gain the ſole property of the fruit, which he had gathered for his own repaſt. A doctrine well illuſtrated by Cicero, who compares the world to a great theatre, which is common to the public, and yet the place which any man has taken is for the time his own.

Blackſt. Comment.

5 Riſe of permanent property in various things.

But when mankind increaſed in number, craft, and ambition, it became neceſſary to entertain conceptions of more permanent dominion; and to appropriate to individuals, not the immediate *uſe* only, but the very *ſubſtance* of the thing to be uſed: otherwiſe innumerable tumults muſt have ariſen, and the good order of the world been continually broken and diſturbed, while a variety of perſons were ſtriving who ſhould get the firſt occupation of the ſame thing, or diſputing which of them had actually gained it. As human life alſo grew more and more refined, abundance of conveniencies were deviſed to render it more eaſy, commodious, and agreeable; as habitations for ſhelter and ſafety, and raiment for warmth and decency. But no man would be at the trouble to provide either, ſo long as he had only an uſufructuary property in them, which was to ceaſe the inſtant that he quitted poſſeſſion;—if, as ſoon as he walked out of his tent, or pulled off his garment, the next ſtranger who came by would have a right to inhabit the one and to wear the other. In caſe of habitations in particular, it was natural to obſerve, that even the brute creation, to whom every thing elſe was in common, maintained a permanent property in their dwellings, eſpecially for the protection of their young; that the birds of the air had neſts, and the beaſts of the field had caverns, the invaſion of which they eſteemed a very flagrant injuſtice, and would ſacrifice their lives to preſerve them. Hence a property was ſoon eſtabliſhed in every man's houſe and home-ſtall; which ſeem to have been originally mere temporary huts or moveable cabins, ſuited to the deſign of Providence for more ſpeedily peopling the earth, and ſuited to the wandering life of their owners, before any extenſive property in the ſoil or ground was eſtabliſhed. And there can be no doubt, but that moveables of every kind became ſooner appropriated than the permanent ſubſtantial ſoil: partly becauſe they were more ſuſceptible of a long occupancy, which might be continued for months together without any ſenſible interruption, and at length by uſage ripen into an eſtabliſhed right; but principally becauſe few of them could be fit for uſe, till improved and meliorated by the bodily labour of the occupant; which bodily labour, beſtowed upon any ſubject which before lay in common to all men, is univerſally allowed to give the faireſt and moſt reaſonable title to an excluſive property therein.

6 In food and other neceſſary articles.

The article of food was a more immediate call, and therefore a more early conſideration. Such as were not contented with the ſpontaneous product of the earth ſought for a more ſolid refreſhment in the fleſh of beaſts, which they obtained by hunting. But the frequent diſappointments incident to that method of proviſion induced them to gather together ſuch animals as were of a more tame and ſequacious nature; and to eſtabliſh a permanent property in their flocks and herds, in order to ſuſtain themſelves in a leſs precarious manner, partly by the milk of their dams, and partly by the fleſh of the young. The ſupport of theſe their cattle made the article of *water* alſo a very important point. And therefore the book of Geneſis (the moſt venerable monument of antiquity, conſidered merely with a view to hiſtory) will furniſh us with frequent inſtances of violent contentions concerning wells; the excluſive property of which appears to have been eſtabliſhed in the firſt digger or occupant, even in ſuch places where the ground and herbage remained

7 Nature of patriarchal property.

remained yet in common. Thus we find Abraham, who was but a ſojourner, aſſerting his right to a well in the country of Abimelech, and exacting an oath for his ſecurity, "becauſe he had digged that well." And Iſaac, about 90 years afterwards, reclaimed this his father's property; and, after much contention with the Philiſtines, was ſuffered to enjoy it in peace.

All this while the ſoil and paſture of the earth remained ſtill in common as before, and open to every occupant: except perhaps in the neighbourhood of towns, where the neceſſity of a ſole and excluſive property in lands (for the ſake of agriculture) was earlier felt, and therefore more readily complied with. Otherwiſe, when the multitude of men and cattle had conſumed every convenience on one ſpot of ground, it was deemed a natural right to ſeize upon and occupy ſuch other lands as would more eaſily ſupply their neceſſities. This practice is ſtill retained among the wild and uncultivated nations that have never been formed into civil ſtates, like the Tartars and others in the eaſt; where the climate itſelf, and the boundleſs extent of their territory, conſpire to retain them ſtill in the ſame ſavage ſtate of vagrant liberty, which was univerſal in the earlieſt ages, and which Tacitus informs us continued among the Germans till the decline of the Roman empire. We have alſo a ſtriking example of the ſame kind in the hiſtory of Abraham and his nephew Lot. When their joint ſubſtance became ſo great, that paſture and other conveniencies grew ſcarce, the natural conſequence was, that a ſtrife aroſe between their ſervants; ſo that it was no longer practicable to dwell together. This contention Abraham endeavoured to compoſe: "Let there be no ſtrife, I pray thee, between thee and me. Is not the whole land before thee? Separate thyſelf, I pray thee, from me: If thou wilt take the left hand, then I will go to the right; or if thou depart to the right hand, then I will go to the left." This plainly implies an acknowledged right, in either, to occupy whatever ground he pleaſed, that was not pre-occupied by other tribes. "And Lot lifted up his eyes, and beheld all the plain of Jordan, that it was well watered every where, even as the garden of the Lord. Then Lot choſe him all the plain of Jordan, and journeyed eaſt; and Abraham dwelt in the land of Canaan."

Upon the ſame principle was founded the right of migration, or ſending colonies to find out new habitations, when the mother-country was overcharged with inhabitants; which was practiſed as well by the Phœnicians and Greeks, as the Germans, Scythians, and other northern people. And, ſo long as it was confined to the ſtocking and cultivation of deſert uninhabited countries, it kept ſtrictly within the limits of the law of nature.

8 Neceſſity of property and of laws reſpecting it.

But as the world by degrees grew more populous, it daily became more difficult to find out new ſpots to inhabit, without encroaching upon former occupants; and by conſtantly occupying the ſame individual ſpot, the fruits of the earth were conſumed, and its ſpontaneous produce deſtroyed, without any proviſion for a future ſupply or ſucceſſion. It therefore became neceſſary to purſue ſome regular method of providing a conſtant ſubſiſtence; and this neceſſity produced, or at leaſt promoted and encouraged, the art of agriculture. And the art of agriculture, by a regular connection and conſequence, introduced and eſtabliſhed the idea of a more permanent property in the ſoil than had hitherto been received and adopted. It was clear that the earth would not produce her fruits in ſufficient quantities without the aſſiſtance of tillage; but who would be at the pains of tilling it, if another might watch an opportunity to ſeize upon and enjoy the product of his induſtry, art, and labour? Had not therefore a ſeparate property in lands, as well as moveables, been veſted in ſome individuals, the world muſt have continued a foreſt, and men have been mere animals of prey; which, according to ſome philoſophers, is the genuine ſtate of nature. Whereas now (ſo graciouſly has Providence interwoven our duty and our happineſs together) the reſult of this very neceſſity has been the ennobling of the human ſpecies, by giving it opportunities of improving its *rational* faculties, as well as of exerting its *natural*. Neceſſity begat property: and in order to inſure that property, recourſe was had to civil ſociety, which brought along with it a long train of inſeparable concomitants; ſtates, government, laws, puniſhments, and the public exerciſe of religious duties. Thus connected together, it was found that a part only of ſociety was ſufficient to provide, by their manual labour, for the neceſſary ſubſiſtence of all; and leiſure was given to others to cultivate the human mind, to invent uſeful arts, and to lay the foundations of ſcience.

9 Property acquired firſt by occupancy.

The only queſtion remaining is, How this property became actually veſted; or what it is that gave a man an excluſive right to retain in a permanent manner that ſpecific land which before belonged generally to every body, but particularly to nobody? And as we before obſerved, that *occupancy* gave the right to the temporary *uſe* of the ſoil, ſo it is agreed upon all hands, that occupancy gave alſo the original right to the permanent property in the *ſubſtance* of the earth itſelf, which excludes every one elſe but the owner from the uſe of it. There is indeed ſome difference among the writers on natural law, concerning the reaſon why occupancy ſhould convey this right, and inveſt one with this abſolute property: Grotius and Puffendorf inſiſting, that this right of occupancy is founded upon a tacit and implied aſſent of all mankind, that the firſt occupant ſhould become the owner; and Barbeyrac, Titius, Mr Locke, and others, holding, that there is no ſuch implied aſſent, neither is it neceſſary that there ſhould be; for that the very act of occupancy, alone, being a degree of bodily labour, is from a principle of natural juſtice, without any conſent or compact, ſufficient of itſelf to gain a title. A diſpute that favours too much of nice and ſcholaſtic refinement. However, both ſides agree in this, that occupancy is the thing by which the title was in fact originally gained; every man ſeizing to his own continued uſe ſuch ſpots of ground as he found moſt agreeable to his own convenience, provided he found them unoccupied by any one elſe.

10 By what means it is preſerved or loſt.

Property, both in lands and moveables, being thus originally acquired by the firſt taker, which taking amounts to a declaration, that he intends to appropriate the thing to his own uſe, it remains in him, by the principle of univerſal law, till ſuch time as he does ſome other act which ſhows an intention to abandon it; for then it becomes, naturally ſpeaking, *publici juris* once more, and is liable to be again appropriated by the next occupant. So if one is poſſeſſed of a jewel, and caſts it into the ſea or a public highway, this is ſuch an expreſs dereliction, that a property will be veſted in the firſt fortunate finder that ſhall ſeize it to his own uſe. But if he hides it privately in the earth, or other ſecret place, and it is diſcovered, the finder acquires no property therein; for the owner hath not by this act declared any intention to abandon it, but rather the contrary: and if he loſes or drops it by accident, it cannot be collected from thence that he deſigned to quit the poſſeſſion; and therefore in ſuch caſe the property ſtill remains in the loſer, who may claim it again of the finder. And this, we may remember, is the doctrine of the Engliſh law with relation to *Treasure-Trove*.

But this method, of one man's abandoning his property, and another ſeizing the vacant poſſeſſion, however well founded in theory, could not long ſubſiſt in fact. It was calculated merely for the rudiments of civil ſociety, and neceſſarily ceaſed among the complicated intereſts and artificial refinements of polite and eſtabliſhed governments. In theſe it was found, that what became inconvenient or uſeleſs to one man, was highly convenient and uſeful to another; who was ready to give in exchange for it ſome equivalent that was equally deſirable to the former proprietor. This mutual convenience introduced commercial traffic, and the reciprocal transfer of property by ſale, grant, or conveyance: which may be conſidered either as a continuance of the original poſſeſſion which the firſt occupant had; or as an abandoning of the thing by the preſent owner, and an immediate ſucceſſive occupancy of the ſame by the new proprietor. The voluntary dereliction of the owner, and delivering the poſſeſſion to another individual, amount to a transfer of the property; the proprietor declaring his intention no longer to occupy the thing himſelf, but that his own right of occupancy ſhall be veſted in the new acquirer. Or, taken in the other light, if I agree to part with an acre of my land to Titius, the deed of conveyance is an evidence of my intending to abandon the property; and Titius, being the only or firſt man acquainted with ſuch my intention, immediately ſteps in and ſeizes the vacant poſſeſſion: thus the conſent expreſſed by the conveyance gives Titius a good right againſt me; and poſſeſſion or occupancy confirms that right againſt all the world beſides.

11
How it goes on the death of the occupant.

The moſt univerſal and effectual way of abandoning property is by the death of the occupant: when, both the actual poſſeſſion and intention of keeping poſſeſſion ceaſing, the property, which is founded upon ſuch poſſeſſion and intention, ought alſo to ceaſe of courſe. For, naturally ſpeaking, the inſtant a man ceaſes to be, he ceaſes to have any dominion: elſe, if he had a right to diſpoſe of his acquiſitions one moment beyond his life, he would alſo have a right to direct their diſpoſal for a million of ages after him; which would be highly abſurd and inconvenient (A). All property muſt therefore ceaſe upon death, conſidering men as abſolute individuals, and unconnected with civil ſociety: for then, by the principles before eſtabliſhed, the next immediate occupant would acquire a right in all that the deceaſed poſſeſſed. But as, under civilized governments, which are calculated for the peace of mankind, ſuch a conſtitution would be productive of endleſs diſturbances, the univerſal law of almoſt every nation (which is a kind of ſecondary law of nature) has either given the dying perſon a power of continuing his property, by diſpoſing of his poſſeſſions by will; or, in caſe he neglects to diſpoſe of it, or is not permitted to make any diſpoſition at all, the municipal law of the country then ſteps in, and declares who ſhall be the ſucceſſor, repreſentative, or heir of the deceaſed; that is, who alone ſhall have a right to enter upon this vacant poſſeſſion, in order to avoid that confuſion which its becoming again common would occaſion. And further, in caſe no teſtament be permitted by the law, or none be made, and no heir can be found ſo qualified as the law requires, ſtill, to prevent the robuſt title of *occupancy* from again taking place, the doctrine of eſcheats is adopted in almoſt every country; whereby the ſovereign of the ſtate, and thoſe who claim under his authority, are the ultimate heirs, and ſucceed to thoſe inheritances to which no other title can be formed.

12
Of the right of inheritance.

The right of inheritance, or deſcent to the children and relations of the deceaſed, ſeems to have been allowed much earlier than the right of deviſing by teſtament. We are apt to conceive at the firſt view that it has nature on its ſide; yet we often miſtake for nature what we find eſtabliſhed by long and inveterate cuſtom. It is certainly a wiſe and effectual, but clearly a political, eſtabliſhment; ſince the permanent right of property, veſted in the anceſtor himſelf, was no *natural*, but merely a *civil*, right. It is true, that the tranſmiſſion of one's poſſeſſions to poſterity has an evident tendency to make a man a good citizen and a uſeful member of ſociety: it ſets the paſſions on the ſide of duty, and prompts a man to deſerve well of the public, when he is ſure that the reward of his ſervices will not die with himſelf, but be tranſmitted to thoſe with whom he is connected by the deareſt and moſt tender affections. Yet, reaſonable as this foundation of the right of inheritance may ſeem, it is probable that its immediate original aroſe not from ſpeculations altogether ſo delicate and refined, and, if not from fortuitous circumſtances, at leaſt from a plainer and more ſimple principle. A man's children or neareſt relations are uſually about him on his death-bed, and are the earlieſt witneſſes of his deceaſe. They became therefore generally the next immediate occupants, till at length in proceſs of time this frequent uſage ripened into general law. And therefore alſo in the earlieſt ages, on failure of children, a man's ſervants born under his roof were allowed to be his heirs; being immediately on the ſpot when he died. For we find the old patriarch Abraham expreſsly declaring, that "ſince God had given him no ſeed, his ſteward Eliezer, one born in his houſe, was his heir."

While property continued only for life, teſtaments

(A) This right, inconvenient as it certainly is, the law of Scotland gives to every man over his *real* eſtate, by authoriſing him to entail it on his heirs forever. See Law, clxxx. 9, 10, 11. and Tailzie.

13
Laſt wills or teſtaments.

were uſeleſs and unknown; and when it became inheritable, the inheritance was long indefeaſible, and the children or heirs at law were incapable of excluſion by will. Till at length it was found, that ſo ſtrict a rule of inheritance made heirs diſobedient and headſtrong, defrauded creditors of their juſt debts, and prevented many provident fathers from dividing or charging their eſtates as the exigence of their families required. This introduced pretty generally the right of diſpoſing of one's property, or a part of it, by *teſtament;* that is, by written or oral inſtructions properly *witneſſed* and authenticated, according to the *pleaſure* of the deceaſed; which we therefore emphatically ſtyle his *will.* This was eſtabliſhed in ſome countries much later than in others. In England, till modern times, a man could only diſpoſe of one-third of his moveables from his wife and children; and, in general, no will was permitted of lands till the reign of Henry VIII. and then only of a certain portion; for it was not till after the Reſtoration that the power of deviſing real property became ſo univerſal as at preſent.

14
Are creatures of the civil or municipal laws.

Blackſt. Comment.

Wills, therefore, and teſtaments, rights of inheritance, and ſucceſſions, are all of them creatures of the civil or municipal laws, and accordingly are in all reſpects regulated by them; every diſtinct country having different ceremonies and requiſites to make a teſtament completely valid; neither does any thing vary more than the right of inheritance under different national eſtabliſhments. In England particularly, this diverſity is carried to ſuch a length, as if it had been meant to point out the power of the laws in regulating the ſucceſſion to property, and how futile every claim muſt be that has not its foundation in the poſitive rules of the ſtate. In perſonal eſtates, the father may ſucceed to his children; in landed property, he never can be their immediate heir by any the remoteſt poſſibility: in general, only the eldeſt ſon, in ſome places only the youngeſt, in others all the ſons together, have a right to ſucceed to the inheritance: In real eſtates, males are preferred to females, and the eldeſt male will uſually exclude the reſt; in the diviſion of perſonal eſtates, the females of equal degree are admitted together with the males, and no right of primogeniture is allowed.

15
Scruples reſpecting heritable property removed.

This one conſideration may help to remove the ſcruples of many well-meaning perſons, who ſet up a miſtaken conſcience in oppoſition to the rules of law. If a man diſinherits his ſon, by a will duly executed, and leaves his eſtate to a ſtranger, there are many who conſider this proceeding as contrary to natural juſtice; while others ſo ſcrupulouſly adhere to the ſuppoſed intention of the dead, that if a will of lands be atteſted by only *two* witneſſes inſtead of *three,* which the law requires, they are apt to imagine that the heir is bound in conſcience to relinquiſh his title to the deviſee. But both of them certainly proceed upon very erroneous principles: as if, on the one hand, the ſon had by nature a right to ſucceed to his father's lands: or as if, on the other hand, the owner was by nature entitled to direct the ſucceſſion of his property after his own deceaſe. Whereas the law of nature ſuggeſts, that on the death of the poſſeſſor, the eſtate ſhould again become common, and be open to the next occupant, unleſs otherwiſe ordered, for the ſake of civil peace, by the poſitive law of ſociety. The poſitive law of ſociety, which is the municipal laws of England and Scotland, directs it to veſt in ſuch perſon as the laſt proprietor ſhall by will, attended with certain requiſites, appoint; and, in defect of ſuch appointment, to go to ſome particular perſon, who, from the reſult of certain local conſtitutions, appears to be the heir at law. Hence it follows, that, where the appointment is regularly made, there cannot be a ſhadow of right in any one but the perſon appointed: and, where the neceſſary requiſites are omitted, the right of the heir is equally ſtrong and built upon as ſolid a foundation, as the right of the deviſee would have been, ſuppoſing ſuch requiſites were obſerved.

16
Of things that are ſtill in common.

But, after all, there are ſome few things, which, notwithſtanding the general introduction and continuance of property, muſt ſtill unavoidably remain in common; being ſuch wherein nothing but an uſufructuary property is capable of being had: and therefore they ſtill belong to the firſt occupant, during the time he holds poſſeſſion of them, and no longer. Such (among others) are the elements of light, air, and water; which a man may occupy by means of his windows, his gardens, his mills, and other conveniences: ſuch alſo are the generality of thoſe animals which are ſaid to be *feræ naturæ,* or of a wild and untameable diſpoſition; which any man may ſeize upon and keep for his own uſe or pleaſure. All theſe things, ſo long as they remain in poſſeſſion, every man has a right to enjoy without diſturbance; but if once they eſcape from his cuſtody, or he voluntarily abandons the uſe of them, they return to the common ſtock, and any other man has an equal right to ſeize and enjoy them afterwards.

17
Of ſimilar things which have been appropriated.

Again, there are other things in which a permanent property may ſubſiſt, not only as to the temporary uſe, but alſo the ſolid ſubſtance; and which yet would be frequently found without a proprietor, had not the wiſdom of the law provided a remedy to obviate this inconvenience. Such are foreſts and other waſte grounds, which were omitted to be appropriated in the general diſtribution of lands: ſuch alſo are wrecks, eſtrays, and that ſpecies of wild animals, which the arbitrary conſtitutions of poſitive law have diſtinguiſhed from the reſt by the well-known appellation of *game.* With regard to theſe and ſome others, as diſturbances and quarrels would frequently ariſe among individuals contending about the acquiſition of this ſpecies of property by firſt occupancy, the law has therefore wiſely cut up the root of diſſenſion, by veſting the things themſelves in the ſovereign of the ſtate; or elſe in his repreſentatives appointed and authoriſed by him, being uſually the lords of manors. And thus the legiſlature has univerſally promoted the grand ends of civil ſociety, the peace and ſecurity of individuals, by ſteadily purſuing that wiſe and orderly maxim, of aſſigning to every thing capable of ownerſhip a legal and determinate owner.

18
The reaſoning of thoſe who contend for an equalization of property.

In this age of paradox and innovation, much has been ſaid of *liberty* and *equality;* and ſome few have contended for an equalization of property. One of the wildeſt declaimers on this ſubject, who is for aboliſhing property altogether, has (inadvertently we ſuppoſe) given a complete confutation, not only of his own arguments, but alſo of the arguments of all who have written, or, we think, can write, on the ſame ſide of the queſtion. After labouring to prove that it is groſs injuſtice in any man to retain more than is abſolutely neceſſary to ſupply him with food, cloathes, and ſhelter, this zealous reformer ſtates an objection to his theory, ariſing from the well-known allurements of ſloth, which, if the accumulation of property were not permitted, would baniſh induſtry from the whole world. The objection he urges fairly, and anſwers it thus: "It may be obſerved, that the equality for which we are pleading is an equality that would ſucceed to a ſtate of great intellectual improvement. So bold a revolution cannot take place in human affairs, till the general mind has been highly cultivated. The preſent age of mankind is greatly enlightened; but it is to be feared is not yet enlightened enough. Haſty and undigeſted tumults may take place, under the idea of an equalization of property; but it is only a calm and clear conviction of juſtice, of juſtice mutually to be rendered and received, of happineſs to be produced by the *deſertion of our moſt rooted habits*, that can introduce an invariable ſyſtem of this ſort. Attempts without this preparation will be productive only of confuſion. Their effect will be momentary, and a new and more barbarous inequality will ſucceed. Each man with unaltered appetite will watch his opportunity to gratify his love of power, or his love of diſtinction, by uſurping on his inattentive neighbours."

19 The effect of ignorance of human nature.

Theſe are juſt obſervations, and ſuch as we have often made to ourſelves on the various propoſed reformations of government. The illumination which the author requires before he would introduce his abolition of property, would conſtitute men more than angels; for to be under the influence of no paſſion or appetite, and to be guided in every action by unmixed benevolence and pure intellect, is a degree of perfection which we can attribute to no being inferior to God. But it is the object of the greater part of this writer's book to prove that all men muſt arrive at ſuch perfection before his ideal republic can contribute to their happineſs; and therefore every one who is conſcious of being at any time ſwayed by paſſion, and who feels that he is more attached to his wife or children than to ſtrangers, will look without envy to the preſent inequalities of property and power, if he be an intelligent diſciple of Mr Godwin.

Literary PROPERTY. See *Copy-Right*.

1 Definition.

PROPHECY is a word derived from προφητεια, and in its original import ſignifies the prediction of future events.

2 Prophecy proves a ſupernatural communion with the Deity.

3 The profeſſors of all religions have pretended to it.

As God alone can perceive with certainty the future actions of free agents, and the remote conſequences of thoſe laws of nature which he himſelf eſtabliſhed, prophecy, when clearly fulfilled, affords the moſt convincing evidence of an intimate and ſupernatural communion between God and the perſon who uttered the prediction. Together with the power of working miracles, it is indeed the only evidence which can be given of ſuch a communion. Hence among the profeſſors of every religious ſyſtem, except that which is called the religion of nature, there have been numberleſs pretenders to the gift of prophecy. The pagan nations of antiquity had their oracles, augurs, and ſoothſayers. Modern idolators have their necromancers and divines and the Jews, Chriſtians, and Mahometans, have their ſeers and prophets.

The ill-founded pretenſions of paganiſm, ancient and modern, have been expoſed under various articles of this work. See DIVINATION, MAGIC, NECROMANCY, and MYTHOLOGY). And the claims of the Arabian impoſtor are examined under the articles ALCORAN and MAHOMETANISM; ſo that at preſent we have only to conſider the uſe, intent, and truth, of the Jewiſh and Chriſtian prophecies.

4 The word in Scripture has various meanings.

Previous to our entering on this inveſtigation it may be proper to obſerve, that in the Scriptures of the Old and New Teſtaments, the ſignification of the word prophecy is not always confined to the foretelling of future events. In ſeveral inſtances it is of the ſame import with preaching, and denotes the faculty of illuſtrating and applying to preſent practical purpoſes the doctrines of prior revelation. Thus in Nehemiah it is ſaid, "thou haſt appointed prophets to preach *;" and whoever ſpeaketh unto men to edification, and exhortation and comfort, is by St Paul called a *prophet*†. Hence it was that there were ſchools of prophets in Iſrael. where young men were inſtructed in the truths of religion, and fitted to exhort and comfort the people.

In this article, however, it is chiefly of importance to confine ourſelves to that kind of prophecy, which, in declaring truths either paſt, preſent, or future, required the immediate inſpiration of God.

5 Science and religion gradually acquired.

Every one who looks into the hiſtory of the world muſt obſerve that the minds of men have from the beginning been gradually opened by a train of events ſtill improving upon, and adding light to each other; as that of each individual is, by proceeding from the firſt elements and ſeeds of ſcience, to more enlarged views, and a ſtill higher growth. Mankind neither are nor ever have been capable of entering into the depths of knowledge at once; of receiving a whole ſyſtem of natural or moral truths together; but muſt be let into them by degrees, and have them communicated by little and little, as they are able to bear it. That this is the caſe with reſpect to human ſcience, is a fact which cannot be queſtioned; and there is as little room to queſtion it with reſpect to the progreſs of religious knowledge among men either taken collectively or in each individual. Why the caſe is thus in both, why all are not adult at once in body and mind, is a queſtion which the religion of nature is equally called upon with revelation to anſwer. The fact may not be eaſily accounted for, but the reality of it is incontrovertible.

5 The revelation of the Old Teſtament gradual.

Accordingly, the great object of the ſeveral revelations recorded in the Old Teſtament was evidently to keep alive a ſenſe of religion in the minds of men, and to train them by degrees for the reception of thoſe ſimple but ſublime truths by which they were to be ſaved. The notions which the early deſcendants of Adam entertained of the Supreme Being, and of the relation in which they ſtood to him, were probably very groſs; and we ſee them gradually refined by a ſeries of revelations or prophecies, each in ſucceſſion more explicit than that by which it was preceded, till the advent of Him who was the way, the truth, and the life, and who brought to light life and immortality.

When a revelation was made of any important truth, the grounds of which the mind of man has not facul-

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* Ch. vi. v. 7.

† 1 Cor. ch. xiv. v. 3.

7 Prophecy always accompanied by miracles.

ties to comprehend, that revelation, though undoubtedly a prophecy, muſt have been ſo far from confirming the truth of revealed religion in general, that it could not gain credit itſelf, but by ſome extrinſic evidence that it came indeed from God. Hence we find Moſes, after it was revealed to him from the burning buſh that he ſhould deliver his countrymen from Egyptian bondage, replying, "Behold, they will not believe me, nor hearken to my voice; for they will ſay, the Lord hath not appeared unto thee." This revelation certainly conſtituted him a prophet to Iſrael; and there cannot be a doubt but that he perfectly knew the divine ſource from which he received it: but he very naturally and reaſonably concluded, that the children of Iſrael would not believe that the Lord had appeared to him, unleſs he could give them ſome other proof of this preternatural appearance than his own ſimple affirmation of its reality. This proof he was immediately enabled to give, by having conferred upon him the power of working miracles in confirmation of his prophecy. Again, when Gideon was called to the deliverance of Iſrael, the angel of the Lord came and ſaid unto him, "The Lord is with thee, thou mighty man of valour: go in this thy might, and thou ſhalt ſave Iſrael from the hand of the Midianites. Have not I ſent thee?" Here was a prophecy delivered by the angel of the Lord to encourage Gideon's undertaking: but he, being probably afraid of ſome illuſion of ſenſe or imagination, demanded a ſign that he was really an angel who talked with him. A ſign is accordingly given him, a miraculous ſign, with which he is ſatisfied, and undertakes the work appointed him.

8 And of itſelf can be no proof of a revelation.

From theſe and many ſimilar tranſactions recorded in the Old Teſtament, it appears that prophecy was never intended as evidence of an original revelation. It is indeed, by its very nature, totally unfit for ſuch a purpoſe; becauſe it is impoſſible, without ſome extrinſic proof of its divine origin, to know whether any prophecy be true or falſe, till the era arrive at which it ought to be fulfilled. When it is fulfilled, it affords complete evidence that he who uttered it ſpake by the ſpirit of God, and that the doctrines which he taught of a religious nature, were all either dictated by the ſame ſpirit, or at leaſt are true, and calculated to direct mankind in the way of their duty.

9 It was intended to preſerve a ſenſe of religion among men.

The prophecies vouchſafed to the patriarchs in the moſt early periods of the world, were all intended to keep alive in their minds a ſenſe of religion, and to direct their views to the future completion of that firſt and greateſt prophecy which was made to Adam immediately on his fall: but in order to ſecure credit to thoſe prophecies themſelves, they were always accompanied by ſome miraculous ſign that they were indeed given by the God of truth, and not the deluſions of fanaticiſm or hypocriſy. Prophecy, in the proper ſenſe of the word, commenced with the fall; and the firſt inſtance of it is implied in the ſentence denounced upon the original deceiver of mankind; "I will put enmity between thee and the woman, and between thy ſeed and her ſeed: It ſhall bruiſe thy head, and thou ſhalt bruiſe his heel.

10 Probable effects of the firſt prophecy on our firſt parents.

This prophecy, though one of the moſt important that ever was delivered, when conſidered by itſelf, is exceedingly obſcure. That Adam ſhould have underſtood it, as ſome of his degenerate ſons have pretended to do, in a literal ſenſe, is abſolutely impoſſible. He knew well that it was the great God of heaven and earth who was ſpeaking, and that ſuch a being was incapable of trifling with the wretchedneſs of his fallen creature. The ſentence denounced upon himſelf and his wife was awful and ſevere. The woman was doomed to ſorrow in conception; the man to ſorrow and travel all the days of his life. The ground was curſed for his ſake; and the end of the judgment was, "Duſt thou art, and to duſt thou ſhalt return." Had our firſt parents been thus left, they muſt have looked upon themſelves as rejected by their Maker, delivered up to trouble and ſorrow in the world, and as having no hope in any other. With ſuch impreſſions on their minds they could have retained no ſenſe of religion; for religion, when unaccompanied by hope, is a ſtate of frenzy and diſtraction: yet it is certain that they could have no hope from any thing expreſsly recorded by Moſes, except what they might draw from this ſentence paſſed on their deceiver. Let us then endeavour to aſcertain what conſolation it could afford them.

At that awful juncture, they muſt have been ſenſible that their fall was the victory of the ſerpent, whom by experience they had found to be an enemy to God and to man. It could not therefore but be ſome comfort to them to hear this enemy firſt condemned, and to ſee that, however he had prevailed againſt them, he had gained no victory over their Maker. By his condemnation they were ſecured from thinking that there was any malignant being equal to the Creator in power and dominion; an opinion which, through the prevalency of evil, gained ground in after times, and was deſtructive of all true religion. The belief of God's ſupreme dominion being thus preſerved, it was ſtill neceſſary to give them ſuch hopes as might induce them to love as well as to fear him; and theſe they could not but conceive when they heard from the mouth of their Creator and Judge, that the ſerpent's victory was not complete even over themſelves; that they and their poſterity ſhould be enabled to conteſt his empire; and that though they were to ſuffer much in the ſtruggle, they ſhould yet finally prevail, bruiſe the ſerpent's head, and deliver themſelves from his power and dominion.

This prophecy therefore was to our firſt parents a light ſhining in a dark place. All that they could certainly conclude from it was, that their caſe was not deſperate; that ſome remedy, ſome deliverance from the evil they were under, would in time appear; but *when* or *where*, or by *what means* they were to be delivered, they could not poſſibly underſtand, unleſs the matter was further revealed to them, as probably it was at the inſtitution of ſacrifice (ſee Sacrifice). Obſcure, however, as this promiſe or prophecy was, it ſerved after the fall as a foundation for religion, and truſt and confidence towards God in hopes of deliverance in time from the evils of diſobedience: and this appears to have been the ſole purpoſe for which it was given, and not, as ſome well-meaning, though weak advocates for Chriſtianity have imagined, as a prediction pointing *directly* to the croſs of Chriſt.

As this prophecy was the firſt, ſo is it the only conſiderable one in which we have any concern from the creation to the days of Noah. It was proportioned to the then wants and neceſſities of the world, and was the grand charter of God's mercy after the fall. Nature had no certain help for ſinners; her rights were loſt with her innocence. It was therefore neceſſary either to deſtroy the offenders, or to raiſe them to a capacity of ſalvation, by giving them ſuch hopes as might enable them to exerciſe a reaſonable religion. So far the light of this prophecy extended. By what *means* God intended to work their ſalvation, he did not expreſsly declare: and who has a right to complain that he did not, or to preſcribe to him rules in diſpenſing his mercy to the children of men?

11
The curſe removed from the ground.

Upon the hopes of mercy which this prophecy gives in very general terms, mankind reſted till the birth of Noah. At that period a new prophecy was delivered by Lamech, who foretels that his ſon ſhould comfort them concerning the work and toil of their hands, "becauſe of the *earth which the Lord had curſed.*" We are to remember that the curſe pronounced upon the earth was part of the ſentence paſſed upon our firſt parents; and when that part was remitted, if it ever was remitted, mankind would acquire new and more lively hopes that in God's good time they ſhould be freed from the whole. But it has been ſhown by biſhop Sherlock *, that this declaration of Lamech's was a prediction, that during the life of his ſon the curſe ſhould be taken off from the earth: and the ſame prelate has proved with great perſpicuity, and in the moſt ſatisfactory manner, that this happy revolution actually took place after the flood. The limits preſcribed to an article of this kind will not permit us even to abridge his arguments. We ſhall only obſerve, that the truth of his concluſion is manifeſt from the very words of ſcripture; for when God informs Noah of his deſign to deſtroy the world, he adds, "But with thee will I eſtabliſh my covenant:" and as ſoon as the deluge was over, he declared that he "would not again curſe the ground any more for man's ſake; but that while the earth ſhould remain, ſeed-time and harveſt, and cold and heat, and ſummer and winter, and day and night, ſhould not ceaſe." From this laſt declaration it is apparent that a curſe *had* been on the earth, and that ſeed-time and harveſt had often failed; that the curſe was now taken off; and that in conſequence of this covenant, as it is called, with Noah and his ſeed and with every living creature, mankind ſhould not henceforth be ſubject to toil ſo ſevere and ſo generally fruitleſs.

12
A future life not then explicitly revealed.

It may ſeem ſurpriſing perhaps to ſome, that after ſo great a revolution in the world as the deluge made, God ſhould ſay nothing to the remnant of mankind of the puniſhments and rewards of another life, but ſhould make a new covenant with them relating merely to fruitful ſeaſons and the bleſſings of the earth. But in the ſcriptures we ſee plainly a gradual working of providence towards the redemption of the world from the curſe of the fall; that the temporal bleſſings were firſt reſtored as an earneſt and pledge of better things to follow; and that the covenant given to Noah had, ſtrictly ſpeaking, nothing to do with the hopes of futurity, which were reſerved to be the matter of another covenant, in another age, and to be revealed by him, whoſe province it was to "bring life and immortality to light through the goſpel." But if Noah and his forefathers expected deliverance from the whole curſe of the fall, the actual deliverance from one part of it was a very good pledge of a further deliverance to be expected in time. Man himſelf was curſed as well as the ground; he was doomed to duſt; and fruitful ſeaſons are but a ſmall relief, compared to the greatneſs of his loſs. But when fruitful ſeaſons came, and one part of the curſe was evidently abated, it gave great aſſurance that the other ſhould not laſt forever, but that by ſome means, ſtill unknown to them, they ſhould be freed from the whole, and finally bruiſe the ſerpent's head, who, at the deluge, had ſo ſeverely bruiſed man's heel.

Upon this aſſurance mankind reſted for ſome generations, and practiſed, as we have every reaſon to believe, a rational worſhip to the one God of the univerſe. At laſt, however, idolatry was by ſome means or other introduced (ſee POLYTHEISM), and ſpread ſo univerſally through the world, that true religion would in all probability have entirely failed, had not God viſibly interpoſed to preſerve ſuch a ſenſe of it as was neceſſary for the accompliſhment of his great deſign to reſtore mankind. This he did by calling Abraham from amidſt his idolatrous kindred, and renewing to him the word of prophecy: "Get thee out of thy country (ſaid he), and from thy kindred, and from thy father's houſe, unto a land that I will ſhew thee. And I will make of thee a great nation, and I will bleſs thee and make thy name great; and thou ſhalt be a bleſſing. And I will bleſs them that bleſs thee, and curſe them that curſe thee; and in thee ſhall all the families of the earth be bleſſed." Theſe magnificent promiſes are ſeveral times repeated to the father of the faithful with additional circumſtances of great importance, ſuch as, "that he ſhould be multiplied exceedingly; that he ſhould be a father of many nations; that kings ſhould come out of him;" and above all, that God would eſtabliſh an *everlaſting covenant* with him and his ſeed, to give him and them all the land of Canaan for an *everlaſting poſſeſſion*, and to be *their God.*"

13
Promiſe to Abraham.

Upon ſuch of theſe promiſes as relate to temporal bleſſings we need not dwell. They are much of the ſame nature with thoſe which had been given before to Lamech, Noah, Shem, and Japheth; and all the world knows how amply and literally they have been fulfilled. There was however ſo little probability in nature of their accompliſhment at the time when they were made, that we find the patriarch aſking "Whereby he ſhould *know* † that he ſhould inherit ſuch an extent of country?" And as the promiſes that he ſhould inherit it were meant to be a foundation for religion and confidence in God, a miraculous ſign was given him that they came indeed from the ſpirit of truth. This removed from his mind every doubt, and made him give the fulleſt credit, not only to them, but alſo to that other promiſe, "that in his ſeed ſhould all the nations of the earth be bleſſed."

What diſtinct notion he had of this bleſſing, or in what manner he hoped it ſhould be effected, we cannot pretend to ſay. "But that he underſtood it to be a promiſe of reſtoring mankind, and delivering them from the remaining curſe of the fall, there can be no doubt. He knew that death had entered by ſin; he knew that God had promiſed victory and redemption to the ſeed of the woman. Upon the hopes of this reſtoration the religion of his anceſtors was founded; and when God, from whom this bleſſing on all men was expected, did expreſsly promiſe a bleſſing on all men, and in this promiſe founded his everlaſting covenant—what could Abraham elſe expect but the completion in his ſeed of that ancient promiſe and prophecy concerning the victory to be obtained by the woman's ſeed? The curſe of the ground was expiated in the flood, and the earth reſtored with a bleſſing, which was the foundation of the temporal covenant with Noah; a large ſhare of which God expreſsly grants to Abraham and his poſterity particularly, together with a promiſe to bring, by their means, a new and further bleſſing upon the whole race of men. If we lay theſe things to heart, we cannot ſuppoſe that leſs could be expected from the new promiſe or prophecy given to Abraham than a deliverance from that part of the curſe ſtill remaining on man: *Duſt thou art, and to duſt thou ſhalt return.* In virtue of this covenant Abraham and his poſterity had reaſon to expect that the time would come when man ſhould be called from his duſt again. For this expectation they had his aſſurance who gave the covenant, that he would be their God forever. Well might our Saviour then tell the ſons of Abraham, that even Moſes at the buſh ſhowed the reſurrection of the dead, when he called the Lord the God of Abraham, and the God of Iſaac, and the God of Jacob *."

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* Uſe and Intent of Prophecy.

† Geneſis xv. 8. &c.

14
To Iſaac and Jacob.

15
The law of Moſes and the ſucceeding prophets.

Theſe promiſes made to Abraham were renewed to Iſaac and Jacob; to the laſt of whom it was revealed, not only that all the nations of the earth ſhould be bleſſed in his ſeed, but that the bleſſing ſhould ſpring from his ſon Judah. It is, however, by no means evident that any one of thoſe patriarchs knew preciſely by what *means* (A) the curſe of the fall was to be entirely removed, and all men called from their duſt again. It was enough that they were convinced of the fact in general terms, ſince ſuch conviction was a ſufficient foundation of a rational religion; and the deſcendants of Abraham had no other foundation upon which to reſt their hopes, and pay a cheerful worſhip to the God of their fathers, till the giving of the law to Moſes. Then indeed they were incorporated into a ſociety with municipal laws of their own and placed under a theocratic government; the temporal promiſes made to their fathers were amply fulfilled; religion was maintained among them by rewards and puniſhments equally diſtributed in this world (ſee THEOLOGY): and a ſeries of prophets ſucceeding one another pointed out with greater and greater clearneſs, as the fulneſs of time approached, the perſon who was to redeem mankind from the power of death; by what means he was to work that great redemption, and at what preciſe period he was to make his appearance in the world. By theſe ſupernatural interpoſitions of divine providence, the principles of pure theiſm and the practice of true religion were preſerved among the children of Iſrael, when all other nations were ſunk in the groſſeſt idolatry, and wallowed in the moſt abominable vices; when the far-famed Egyptians, Greeks, and Romans, fell down with adoration to ſtocks and ſtones and the vileſt reptiles; and when they had no well grounded hope of another life, and were in fact without God in the world.

16
Were all intended to keep alive a ſenſe of religion.

From this ſhort deduction, we think ourſelves intitled to conclude, that the *primary* uſe and intent of prophecy, under the various diſpenſations of the Old Teſtament, was not, as is too often ſuppoſed, to eſtabliſh the divine miſſion of Jeſus Chriſt, but to keep alive in the minds of thoſe to whom it was given, a ſenſe of religion, and a hope of future deliverance from the curſe of the fall. It was, in the expreſſive language of St Peter, "a light that ſhone in a dark place, unto which men did well to take heed until the day dawned and the day-ſtar aroſe in their hearts." But though this was certainly the original intent of prophecy (for Chriſt, had he never been foretold, would have proved himſelf to be the Son of God with power by his aſtoniſhing miracles, and his reſurrection from the dead), yet it cannot be denied, that a long ſeries of prophecies, given in different and far diſtant ages, and having all their completion in the life, death, and reſurrection, of Jeſus, concur very forcibly with the evidence of miracles to prove that he was the ſeed of the woman ordained to bruiſe the head of the ſerpent, and reſtore man to his forfeited inheritance. To the Jews the force of this evidence muſt have been equal, if not ſuperior, to that of miracles themſelves; and therefore we find the Apoſtles and firſt preachers of the goſpel, in their addreſſes to them, conſtantly appealing to the law and the prophets, whilſt they urged upon the Gentiles the evidence of miracles.

17
The prophecies to be conſidered in connection.

In order to form a right judgment of the argument for the truth of Chriſtianity drawn from the ſure word of prophecy, we muſt not conſider the prophecies given in the Old Teſtament as ſo many *predictions* only independent of each other; for if we do, we ſhall totally loſe ſight of the purpoſe for which they were originally given, and ſhall never be able to ſatisfy ourſelves when confronted by the objections of unbelievers. It is eaſy for men of leiſure and tolerable parts to find difficulties in particular predictions, and in the application of them made by writers, who lived many hundred years ago, and who had many ancient books and records of the Jewiſh church, from which they drew many paſſages, and perhaps ſome prophecies; which books and records we have not to enable us to underſtand, and to juſtify their applications. But it is not ſo eaſy a matter to ſhow, or to perſuade the world to believe, that a chain of prophecies reaching through ſeveral thouſand years, delivered at different times, yet manifeſtly ſubſervient to one and the ſame adminiſtration of providence from beginning to end, is the effect of art and contrivance and religious fraud. In examining the ſeveral prophecies recorded in the Old Teſtament, we are not to ſuppoſe that each of them *expreſsly* pointed out and *clearly* characterized Jeſus Chriſt. Had they done ſo, inſtead of being a ſupport to religion in general, the purpoſe for which they were originally intended, they would have had a very different effect, by making thoſe to whom they were given repine at being placed under diſpenſations ſo very inferior to that of the goſpel. We are therefore to inquire only whether all the notices, which, in general and often metaphorical terms, God gave to the fathers, of his intended ſalvation, are perfectly anſwered by the coming of Chriſt; and we ſhall find that nothing has been promiſed with reſpect to that ſubject which has not been performed in the ampleſt manner. If we examine the prophecies in this manner, we ſhall find that there is not one of them, which the Apoſtles have applied to the Meſſiah, that is not applicable in a rational and important ſenſe to ſomething in the birth, life, preaching, death, reſurrection, and aſcenſion of Jeſus of Nazareth; that as applied to him they are all conſiſtent with each other; and that though ſome few of them may be applied without abſurdity to perſons and events under the Jewiſh diſpenſation, Chriſt is the only perſon that ever exiſted in whom they all meet as in a centre. In the limits preſcribed us, it is impoſſible that we ſhould enter upon a particular proof of this poſition. It has been proved by numberleſs writers, and, with reſpect to the moſt important prophecies, by none with greater ſucceſs than biſhop Sherlock in his *Uſe and Intent of Prophecy in the ſeveral ages of the world;* a work which we recommend to our readers as one of the moſt valuable on the ſubject in our own or any other language.

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* Sherlock's Uſe and Intent of Prophecy.

(A) This they certainly could not know from the promiſes expreſſed in the very general terms in which they are recorded in the book of Geneſis. It is, however, not improbable that thoſe promiſes, as they immediately received them, were conceived in terms more preciſe and particular; and, at all events, Dr Warburton has proved to the full conviction of every man who is not a determined unbeliever, that Abraham was commanded to ſacrifice his ſon Iſaac, not only as a trial of his obedience, but alſo that God might give him what he earneſtly deſired, a ſcenical repreſentation of the means by which mankind were to be redeemed from death. The learned writer thinks, and his reaſoning compels us to think with him, that to this tranſaction our Saviour alludes when he ſays, "Your father Abraham rejoiced to ſee my *day*, and he ſaw it and was glad."

18 Objection from the obſcurity of prophecy,

But admitting that it would have been improper, for the reaſons already hinted at, to have given a clear and preciſe deſcription of Chriſt, and the Chriſtian diſpenſation, to men who were ordained to live under diſpenſations leſs perfect, how, it may be aſked, comes it to paſs that many of the prophecies applied by the writers of the goſpel to our Saviour and his actions are ſtill dark and obſcure, and ſo far from belonging evidently to him and to him only, that it requires much learning and ſagacity to ſhow even now the connection between ſome prophecies and the events?

19 Anſwered.

In anſwer to theſe queſtions, the learned prelate juſt referred to obſerves, "That the obſcurity of prophecy does not ariſe from hence, that it is a relation or deſcription of ſomething *future;* for it is as eaſy to ſpeak of things future plainly, and intelligibly, as it is of things paſt or preſent. It is not, therefore, of the nature of prophecy to be obſcure; for it may eaſily be made, when he who gives it thinks fit, as plain as hiſtory. On the other ſide, a figurative and dark deſcription of a future event will be figurative and dark ſtill when the event happens; and conſequently will have all the obſcurity of a figurative and dark deſcription as well after as before the event. The prophet Iſaiah deſcribes the peace of Chriſt's kingdom in the following manner: 'The wolf ſhall dwell with the lamb, and the leopard ſhall lie down with the kid, and the calf and the young lion, and the fatling, together, and a little child ſhall lead them.' Nobody, ſome modern Jews excepted, ever underſtood this literally; nor can it now be *literally* applied to the ſtate of the goſpel. It was and is capable of different interpretations: it may mean temporal peace, or that internal and ſpiritual peace—that tranquillity of mind, which ſets a man at peace with God, himſelf, and the world. But whatever the true meaning is, this prophecy does no more obtrude one determinate ſenſe upon the mind ſince the coming of Chriſt than it did before. But then we ſay, the ſtate of the goſpel was very properly prefigured in this deſcription, and is as properly prefigured in a hundred more of the like kind; and ſince they all agree in a fair application to the ſtate of the goſpel, we ſtrongly conclude, that this ſtate was the thing foretold under ſuch expreſſions. So that the argument from prophecy for the truth of Chriſtianity does not reſt on this, that the event has neceſſarily limited and aſcertained the particular ſenſe and meaning of every prophecy; but in this, that every prophecy has in a proper ſenſe been completed by the coming of Chriſt. It is abſurd, therefore, to expect clear and evident conviction from every ſingle prophecy applied to Chriſt; the evidence muſt ariſe from a view and compariſon of all together." It is doubtleſs a great miſtake to ſuppoſe that prophecy was intended ſolely or chiefly for their ſakes in whoſe time the events predicted are to happen. What great occaſion is there to lay in ſo long beforehand the evidence of prophecy to convince men of things that are to happen in their own times; the truth of which they may, if they pleaſe, learn from their own ſenſes? Yet ſome people are apt to talk as if they thought the truth of the events predicted depended very much on the evidence of prophecy: they ſpeak, for inſtance, as if they imagined the certainty and reality of our Saviour's reſurrection were much concerned in the clearneſs of the prophecies relating to that great and wonderful event, and ſeem to think that they are confuting the truth of his reſurrection when they are pointing out the abſurdity of the prophecies relating to it. But can any thing be more abſurd? For what ground or pretence is there to inquire whether the prophecies foretelling that the Meſſiah ſhould die and riſe again do truly belong to Chriſt, unleſs we are firſt ſatisfied that Chriſt died and roſe again?

The part which unbelievers ought to take in this queſtion, if they would make any uſe of prophecy, ſhould be, to ſhow from the prophets that Chriſt was neceſſarily to riſe from the dead; and then to prove that in fact Jeſus never did riſe. Here would be a plain conſequence. But if they like not this method, they ought to let the prophecies alone; for if Chriſt did not riſe, there is no harm done though the prophets have not foretold it. And if they allow the reſurrection of Chriſt, what do they gain by diſcrediting the prophets? The event will be what it is, let the prophecies be what they will.

Theſe conſiderations ſhow how far the goſpel is *neceſſarily* concerned in prophetical evidence, and how clear the prophecies ſhould be. Chriſt claims to be the perſon foretold in the law and the prophets; and as truth muſt ever be conſiſtent with itſelf, this claim muſt be true as well as all others. This is the part then to be tried on the evidence of prophecy: Is Chriſt that perſon deſcribed and foretold under the Old Teſtament or not? Whether all the prophecies relating to him be plain or not plain, it matters little; the ſingle queſtion is, Are there enough plain to ſhow us that Chriſt is the perſon foretold under the Old Teſtament? If there be, we are at an end of our inquiry, and want no farther help from prophecy; eſpecially ſince we have ſeen the day dawn and enjoyed the marvellous light of the goſpel of God.

20
Objections from the clearneſs of ſome prophecies,

But ſo unreaſonable are unbelievers, that whilſt ſome of them object to the obſcurity of the prophecies, others have rejected them altogether on account of their clearneſs, pretending that they are hiſtories and not predictions. The propheſies againſt which this objection has been chiefly urged are thoſe of Daniel, which were firſt called in queſtion by the famous Porphyry. He affirmed that they were not compoſed by Daniel, whoſe name they bear, but by ſome author who lived in Judea about the time of Antiochus Epiphanes; becauſe all to that time contained true hiſtory, but that all the facts beyond that were manifeſtly falſe.

21
Anſwered.

This method of oppoſing the prophecies, as a father of the church rightly obſerves, is the ſtrongeſt teſtimony of their truth: for they are ſo exactly fulfilled, that to infidels the prophet ſeemed not to have foretold things future, but to have related things paſt. To an infidel of this age, if he has the ſame ability and knowledge of hiſtory that Porphyry had, all the ſubſequent prophecies of Daniel, except thoſe which are ſtill fulfilling, would appear to be hiſtory and not prophecy: for it entirely overthrows the notion of their being written in the days of *Antiochus Epiphanes*, or of the *Maccabees*, and eſtabliſhes the credit of Daniel as a prophet beyond contradiction, that there are ſeveral of thoſe prophecies which have been fulfilled ſince that period as well as before; nay, that there are prophecies of Daniel which are fulfilling at this very time in the world.

22
From what has happened ſince the objection was firſt ſtarted.

Our limits will not permit us to enter into the objections which have been made to this prophet by the author of *The Literal Scheme of Prophecy Conſidered*; nor is there occaſion that we ſhould enter into them. They have been all examined and completely anſwered by Biſhop Chandler in his *Vindication of his Defence of Chriſtianity*, by Mr Samuel Chandler in his *Vindication of the Antiquity and Authority of Daniel's Prophecies*, and by Biſhop Newton in his excellent *Diſſertations on the Prophecies*. To theſe authors we refer the reader; and ſhall conclude the preſent article with a view of ſome prophecies given in very remote ages, which are in this age receiving their accompliſhment.

23
And from facts of the preſent age.

Of theſe the firſt is that of Noah concerning the ſervitude of the poſterity of Canaan. In the greater part of original manuſcripts, and in our verſion of the holy ſcriptures, this prophecy is thus expreſſed: "Curſed be Canaan; a ſervant of ſervants ſhall he be unto his brethren:" but in the Arabic verſion, and in ſome copies of the Septuagint, it is, "Curſed be *Ham* the father of Canaan; a ſervant of ſervants ſhall he be to his brethren." Whether the curſe was really pronounced upon Ham, which we think moſt probable, or only upon his ſon Canaan, we ſhall find the prediction remarkably fulfilled, not barely ages after the book of Geneſis was very generally known, but alſo at this very day. It is needleſs to inform any man who has but looked into the Old Teſtament, that when the ancient patriarchs pronounced either a curſe or a bleſſing upon any of their ſons, they meant to declare the future fortunes, not of that ſon individually, but of his deſcendants as a tribe or a nation. Let us keep this in mind, and proceed to compare with Noah's prophecy *firſt* the fortunes of the deſcendants of Canaan, the fourth ſon of Ham, and then the fortunes of the poſterity of Ham by his other ſons.

With the fate of the Canaanites every reader is acquainted. They were conquered by Joſhua ſeveral centuries after the delivery of this prophecy; and ſuch of them as were not exterminated were by him and Solomon reduced to a ſtate of the loweſt ſervitude to the Iſraelites, the poſterity of Shem the brother of Ham. The Greeks and Romans, too, who were the deſcendents of Japheth, not only ſubdued Syria and Paleſtine, but alſo purſued and conquered ſuch of the Canaanites as were anywhere remaining, as for inſtance the Tyrians and Carthaginians, of whom the former were ruined by Alexander and the Grecians, and the latter by Scipio and the Romans. Nor did the effects of the curſe ſtop there. The miſerable remainder of that devoted people have been ever ſince ſlaves to a foreign yoke; firſt to the Saracens who are deſcended from Shem, and afterwards to the Turks who are deſcended from Japheth; and under the Turkiſh dominion they groan at this day.

If we take the prophecy as it ſtands in the Arabic verſion, its accompliſhment is ſtill more remarkable. The whole continent of Africa was peopled principally by the poſterity of Ham. And for how many ages have the better parts of that country lain under the dominion firſt of the Romans, then of the Saracens, and now of the Turks? In what wickedneſs, ignorance, barbarity, ſlavery, and miſery, live moſt of its inhabitants? and of the poor negroes how many thouſands are every year ſold and bought like beaſts in the market, and conveyed from one quarter of the world to do the work of beaſts in another; to the full accompliſhment indeed of the prophecy, but to the laſting diſgrace of thoſe who are from the love of gain the inſtruments of fulfilling it. Nothing can be more complete than the execution of the ſentence as well upon Ham as upon Canaan; and the hardieſt infidel will not dare to ſay that it was pronounced after the event.

The next prophecy which we ſhall notice is that of Abraham concerning the multitude of his deſcendants; which every one knows is ſtill fulfilled in the Jews even in their diſperſed ſtate, and therefore cannot have been given after the event of which it ſpeaks.

Of the ſame kind are the ſeveral prophecies concerning Iſhmael; of which ſome have been fulfilled, and others are at preſent fulfilling in the moſt aſtoniſhing manner. Of this ſon of Abraham it was foretold, that "he ſhould be a wild man; that his hand ſhould be againſt every man, and every man's hand againſt him; that he ſhould dwell in the preſence of all his brethren; that he ſhould be multiplied exceedingly, beget twelve princes, and become a great nation." The ſacred hiſtorian who records theſe prophecies adds, that "God was with the lad, and he grew, and dwelt in the wilderneſs, and became an archer."

To ſhow how fully and literally all theſe prophecies have been accompliſhed, would require more room than we have to beſtow; and to the reader of hiſtory the labour would be ſuperfluous. We ſhall therefore only requeſt the unbeliever to attend to the hiſtory of the Arabs, the undoubted deſcendants of Iſhmael; and to ſay how it comes to paſs, that though they have been robbers by land and pirates by ſea for time immemorial,

rial, though their hands have been againſt every man, and every man's hand againſt them, they always have dwelt, and at this day dwell, in the preſence of their brethren, a free and independent people. It cannot be pretended that no attempt has ever been made to conquer them; for the greateſt conquerors in the world have all in their turns attempted it: but though ſome of them made great grogreſs, not one was ever crowned with ſucceſs. It cannot be pretended that the inacceſſibleneſs of their country has been their protection; for their country has been often penetrated, though it never was entirely ſubdued. When in all human probability they have been on the brink of ruin, they were ſignally and providentially delivered. Alexander was preparing an expedition againſt them, when he was cut off in the flower of his age. Pompey was in the career of his conqueſts, when urgent affairs called him elſewhere. Ælius Gallius had penetrated far into their country, when a fatal diſeaſe deſtroyed great numbers of his men, and obliged him to return. Trajan beſieged their capital city, but was defeated by thunder and lightning and whirlwinds. Severus beſieged the ſame city twice, and was twice repelled from before it. The Turks, though they were able to wreſt from them their foreign conqueſts, have been ſo little able to ſubdue the Arabs themſelves, or even to reſtrain their depredations, that they are obliged to pay them a ſort of annual tribute for the ſafe paſſage of the pilgrims who go to Mecca to pay their devotions. On theſe facts we ſhall not exclaim. He who is not ſtruck upon comparing the ſimple hiſtory of this ſingular people with the prophecies ſo long ago delivered of them and their great anceſtor, whoſe love of liberty is compared to that of the wild aſs, would riſe wholly unmoved from our exclamations.

24
The diſperſion of the Jews plainly foretold,

A fourth prophecy of this kind, which cannot be alleged to have been uttered after the event, is the denunciation of Moſes againſt the children of Iſrael in caſe of their diſobedience; which is ſo literally fulfilled, that even at this moment it appears rather a hiſtory of the preſent ſtate of the Jews, than a remote prediction of their apoſtacy and puniſhment. "And the Lord ſhall ſcatter thee among all people from the one end of the earth even unto the other. And among theſe nations ſhalt thou find no eaſe, neither ſhall the ſole of thy foot have reſt; but the Lord ſhall give thee there a trembling heart, and failing of eyes, and ſorrow of mind. And thy life ſhall hang in doubt before thee; and thou ſhalt fear day and night, and ſhalt have none aſſurance of thy life." (Deut. xxviii. 64, 65, 66.) "And thou ſhalt become an aſtoniſhment, a proverb, and a bye-word, among all nations, whither the Lord ſhall lead you." (Deut. xxviii. 37.)

Similar to this denunciation, but attended with ſome circumſtances ſtill more wonderful, is the following prediction of the prophet Hoſea: "The children of Iſrael ſhall abide many days without a king, and without a prince, and without a ſacrifice, and without an image, and without an ephod, and without teraphim. Afterwards ſhall the children of Iſrael return, and ſeek the Lord their God, and David their king; and ſhall fear the Lord and his goodneſs in the latter days (B)" In this paſſage we find the ſtate of the Jews for the laſt 1700 years clearly and diſtinctly deſcribed with all its circumſtances. From the time that they rejected their Meſſiah all things began to work towards the deſtruction of their polities both civil and religious; and within a few years from his death, their city, temple, and government, were utterly ruined; and they themſelves, not carried into a gentle captivity, to enjoy their laws, and live under governors of their own as they did in Babylon, but they were ſold like beaſts in a market, and became ſlaves in the ſtricteſt ſenſe; and from that day to this have had neither prince nor chief among them. Nor will any one of them ever be able, after all their pretences, to prove his deſcent from Aaron, or to ſay with certainty whether he is of the tribe of Judah or of the tribe of Levi, till he ſhall diſcover that unknown country where never mankind dwelt, and where the apocryphal Eſdras has placed their brethren of the ten tribes. This being the caſe, it is impoſſible they can have either an altar, or a ſacrifice, or a prieſthood, according to the inſtitution of Moſes, but are evidently an outcaſt people living under laws which cannot be fulfilled.

25
And the cauſe of it.

The cauſe of this deplorable condition is likewiſe aſſigned with the ſame perſpicuity: They are ſcattered over the face of the earth, becauſe they do not acknowledge Chriſt for the Meſſiah; becauſe they do not ſubmit to their own king, the true David. In the prophetic writings the name of David is frequently given to the Meſſiah, who was to deſcend from that prince. Thus Ezekiel, ſpeaking of the kingdom of Chriſt, ſays, "I will ſet up one Shepherd over them, and he ſhall feed them, even my ſervant David; he ſhall feed them, and he ſhall be their ſhepherd." And Jeremiah ſays, "They ſhall ſerve the Lord their God, and David their king, whom I ſhall raiſe up unto them."

That in theſe places, as well as in the paſſage under conſideration, the Meſſiah is meant, is undeniable; for David the ſon of Jeſſe was dead long before any of the three prophets was born, and by none of them it is ſaid, "afterwards David their king ſhall come again;" but "afterwards the children of Iſrael ſhall *return* to David their king," they ſhall recover from their blind infatuation, and ſeek him whom they have not yet known. By their not receiving Jeſus for the Chriſt, they have forfeited all claim to the divine favour, and are, of conſequence, "without a king, and without a chief, and without a ſacrifice, and without an altar, and without a prieſthood.

26
Their return alſo foretold.

The time, however, will come, when they ſhall return and ſeek "the Lord their God and David their king;" when they ſhall tremble before him whom their fathers crucified, and honour the ſon even as they honour the father. That this part of the prophecy will in time be as completely fulfilled as the other has been, may be confidently expected from the wonderful preſervation of the Jews for ſo many ages. Scattered as they

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(B) Such is our tranſlation of this remarkable prophecy; but the Greek verſion of the Seventy has it, perhaps more properly, thus: "The children of Iſrael ſhall abide many days without a king, and without a chief, and without ſacrifice, and without an altar, and without a prieſthood, and without prophecies. Afterwards," &c.

they are over the whole earth, and hated as they are by all nations, it might naturally be thought, that in proceſs of time they would have coaleſced with their conquerors, and have been ultimately abſorbed and annihilated by the union, ſo that not a trace of them ſhould now have remained; yet the fact is, that, diſperſed as they have ever ſince been over the whole face of the globe, they have never, in a ſingle inſtance in any country, loſt their religious or national diſtinctions; and they are now generally ſuppoſed to be as numerous as they were under the reigns of David and Solomon. This is contrary to all hiſtory, and all experience of the courſe of human affairs in ſimilar caſes; it has been boldly and juſtly ſtyled a ſtanding miracle. Within 1000 or 1200 years back, a great variety of extraordinary and important revolutions have taken place among the nations of Europe. In the ſouthern part of Britain the Britons were conquered by the Saxons, the Saxons by the Danes, and the Danes and Saxons by the Normans; but in a few centuries theſe oppoſite and hoſtile nations were conſolidated into one indiſtinguiſhable maſs. Italy, about the ſame time that Britain was ſubdued by the Saxons, was conquered by the Goths and Vandals: and it is not eaſy to conceive a more ſtriking contraſt than that which ſubſiſted between the poliſhed inhabitants of that delightful country and their ſavage invaders; and yet how ſoon did all diſtinction ceaſe between them! In France, the Roman colonies gradually aſſimilated with the ancient Gauls; and in Spain, though the Moors continued for ſeveral ages, and till their final expulſion, a diſtinct people, yet after they were once reduced to a ſtate of ſubjection, their numbers very ſenſibly diminiſhed; and ſuch of them as were ſuffered to remain after their laſt overthrow have been long ſince ſo blended with the Spaniards that they cannot now be diſtinguiſhed. But with regard to the Jews, the wonder is, that though they do not in any country where they are ſettled bear any proportion to the natural inhabitants, though they are univerſally reduced to a ſtate of the loweſt ſubjection, and even expoſed to hatred, contempt, and perſecution; yet in no inſtance does there ſeem to be the leaſt appearance or probability of their numbers being diminiſhed, in no inſtance do they diſcover any decay of attachment to their religious principles. Whence then comes it that this people alone, who, having no form of government or a republic anywhere ſubſiſting, are without the means by which other people are kept united and diſtinct, ſhould ſtill be preſerved among ſo many different nations? How comes it, when they have been thus ſcattered into ſo many diſtant corners, like duſt which cannot be perceived, that they ſhould ſtill ſo long ſurvive the diſſolution of their own ſtate, as well as that of ſo many others? To theſe queſtions the anſwer is obvious: They are preſerved, that, as a nation, "they may return and ſeek the Lord their God and David their king, and fear the Lord and his goodneſs in the latter days."

27
Of prophecies reſpecting the Chriſtian church.

We might here ſubjoin many prophecies both from the Old and the New Teſtament, and eſpecially from the writings of St Paul and St John, which ſo clearly deſcribe the various fortunes of the Chriſtian church, her progreſs to that ſtate of general corruption under which ſhe was ſunk three centuries ago, and her gradual reſtoration to her primitive purity, that they cannot be ſuppoſed to proceed from the cunning craftineſs of men, or to have been written after the events of which they ſpeak. To do juſtice to theſe, however, would require a volume, and many excellent volumes have been written upon them. The reader who wiſhes for ſatiſfaction on ſo intereſting a ſubject will do well to conſult the writings of Mr Mede and Sir Iſaac Newton, together with Biſhop Newton's Diſſertations, and the Sermons of Hurd, Halifax, and Bagot, preached at Warburton's lecture. We ſhall only obſerve, that one of the ableſt reaſoners that Great Britain ever produced, after having paid the cloſeſt attention to the predictions of the New Teſtament, hath been bold enough to put the truth of revealed religion itſelf upon the reality of that prophetic ſpirit which foretold the deſolation of Chriſt's church and kingdom by antichriſt. "If (ſays he), IN THE DAYS OF ST PAUL AND ST JOHN, there was any footſtep of ſuch a ſort of power as this in the world; or if there HAD BEEN any ſuch power in the world; or if there WAS THEN any appearance or probability that could make it enter into the heart of man to imagine that there EVER COULD BE any ſuch kind of power in the world, much leſs in the *temple* or *church of God*; and if there be not NOW ſuch a power actually and conſpicuouſly exerciſed in the world; and if any picture of this power, DRAWN AFTER THE EVENT, can now deſcribe it more plainly and exactly than it was originally deſcribed in the words of the prophecy—then may it, with ſome degree of plauſibility, be ſuggeſted, that the prophecies are nothing more than enthuſiaſtic imaginations."

Upon the whole, we conclude with Biſhop Sherlock, that the various prophecies recorded in the Holy Scriptures were given, not to enable man to foreſee with clearneſs future events, but to ſupport the ſeveral diſpenſations of religion under which they were reſpectively promulgated. The principal prophecies recorded in the Old Teſtament led mankind to hope for a complete deliverance from the curſe of the fall; and therefore tended to fill their minds with gratitude, and to enforce a cheerful obedience to that God who in the midſt of judgment remembereth mercy. The prophecies, whether in the Old or New Teſtament, that pourtray the preſent ſtate of the Jews, and the various fortunes of the Chriſtian church, as they are daily fulfilling in the preſence of all men, are the ſtrongeſt poſſible proof of the divinity of our holy religion, and ſupply to us in the latter days the place of miracles, by which it was at firſt eſtabliſhed.

PROPHET, in general, a perſon who foretels future events; but is particularly applied to ſuch inſpired perſons among the Jews as were commiſſioned by God to declare his will and purpoſes to that people. Among the canonical books of the Old Teſtament we have the writings of 16 prophets, four of whom are denominated the *greater prophets*, viz. Iſaiah, Jeremiah, Ezekiel, and Daniel; ſo called from the length or extent of their writings, which exceed thoſe of the others, viz. Hoſea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Zephaniah, Haggai, Zechariah, and Malachi, who are called the *leſſer prophets*, from the ſhortneſs of their writings. The Jews do not place Daniel among the prophets, becauſe, they ſay, he lived the life of a courtier rather than that of a prophet. An account of the ſeveral writings of the prophets may be ſeen each under its particular head. See the article ISAIAH, &c.

Sons of the PROPHETS, in ſcripture hiſtory, an appellation given to young men who were educated in the ſchools or colleges under a proper maſter, who was commonly, if not always, an inſpired prophet, in the kowledge of religion and in ſacred muſic, and thus were qualified to be public preachers; which ſeems to have been part of the buſineſs of the prophets on the Sabbath-days and feſtivals. It is probable that God generally choſe the prophets, whom he inſpired, out of theſe ſchools. See PROPHECY.

PROPITIATION, in theology, a ſacrifice offered to God to aſſuage his wrath and render him propitious. Among the Jews, there were both ordinary and public ſacrifices, as holocauſts, &c. offered by way of thankſgiving; and extraordinary ones, offered by particular perſons guilty of any crime, by way of propitiation. The Romiſh church believe the maſs to be a ſacrifice of propitiation for the living and the dead. The reformed churches allow of no propitiation but that one offered by Jeſus Chriſt on the croſs. See SACRIFICE.

PROPITIATORY, any thing rendering God propitious; as we ſay *propitiatory* ſacrifices, in contradiſtinction to ſacrifices which were *euchariſtical*. Among the Jews the propitiatory was the cover or lid of the ark of the covenant; which was lined both within and withoutſide with plates of gold, inſomuch that there was no wood to be ſeen. This propitiatory was a type or figure of Chriſt, whom St Paul calls the propitiatory ordained from all ages. See *Ark of the Covenant*.

PROPOLIS, the name of a certain ſubſtance more tenacious than wax, with which the bees ſtop up all the holes or cracks in the ſides of their hives. See BEE, nº 13.

PROPONTIS, or SEA OF MARMORA, a part of the Mediterranean, dividing Europe from Aſia; it has the Helleſpont or canal of the Dardanelles to the ſouthweſt, whereby it communicates with the Archipelago, and the ancient Boſphorus of Thrace, or Strait of Conſtantinople, to the north-eaſt, communicating with the Black or Euxine Sea. It has two caſtles: that on the Aſia ſide is on a cape, where formerly ſtood a temple of Jupiter. The caſtle of Europe is on an oppoſite cape, and had anciently a temple of Serapis. It is 120 miles long, and in ſome places upwards of 40 miles broad.

PROPORTION, the identity or ſimilitude of two ratios. Hence quantities that have the ſame ratio between them are ſaid to be proportional; *e. gr.* if A be to B as C to D, or 8 be to 4 as 30 to 15; A, B, C, D, and 8, 4, 30, and 15, are ſaid to be in proportion, or are ſimply called proportionals. Proportion is frequently confounded with ratio; yet have the two in reality very different ideas, which ought by all means to be diſtinguiſhed. Ratio is properly that relation or habitude of two things, which determines the quantity of one from the quantity of another, without the intervention of any third: thus we ſay the ratio of 5 and 10 is 2, the ratio of 12 and 24 is 2. Proportion is the ſameneſs or likeneſs of two ſuch relations: thus the relations between 5 and 10 and 12 and 24 being the ſame, or equal, the four terms are ſaid to be in proportion. Hence ratio exiſts between two numbers, but proportion requires at leaſt three. Proportion, in fine, is the habitude or relation of two ratios when compared together; as ratio is of two quantities. See ALGEBRA, ARITHMETIC, and GEOMETRY.

Arithmetical and Geometrical PROPORTION. See PROGRESSION.

Harmonical or Muſical PROPORTION, is a kind of numeral proportion formed thus: of three numbers, if the firſt be to the third as the difference of the firſt and ſecond to the difference of the ſecond and third; the three numbers are in harmonical proportion.

Thus 2, 3, 6, are harmonical, becauſe 2 : 6 : : 1 : 3. So alſo four numbers are harmonical, when the firſt is to the fourth as the difference of the firſt and ſecond to the difference of the third and fourth.

Thus 24, 16, 12, 9, are harmonical, becauſe 24 : 9 : : 8 : 3. By continuing the proportional terms in the firſt caſe, there ariſes an harmonical progreſſion or ſeries.

1. If three or four numbers in harmonical proportion be multiplied or divided by the ſame number; the products or quotients will alſo be in harmonical proportion: thus, if 6, 8, 12, which are harmonical, be divided by 2, the quotients 3, 4, 6, are alſo harmonical; and reciprocally their products by 2, viz. 6, 8, 12.

2. To find an harmonical mean between two numbers given; divide double the product of the two numbers by their ſum, the quotient is the mean required; thus ſuppoſe 3 and 6 the extremes, the product of theſe is 18, which doubled gives 36; this divided by 9 (the ſum of 3 and 6) gives the quotient 4. Whence 3, 4, 6, are harmonical.

3. To find a third harmonical proportional to two numbers given.

Call one of them the firſt term, and the other the ſecond: multiply them together, and divide the product by the number remaining after the ſecond is ſubtracted from double the firſt; the quotient is a third harmonical proportional: thus, ſuppoſe the given terms 3, 4, their product 12 divided by 2 (the remainder after 4 is taken from 6, the double of the firſt), the quotient is 6, the harmonical third ſought.

4. To find a fourth harmonical proportion to three terms given: multiply the firſt into the third, and divide the product by the number remaining after the middle or ſecond is ſubtracted from double the firſt; the quotient is a third harmonical proportion; thus ſuppoſing the numbers 9, 12, 16, a fourth will be found by the rule to be 24.

5. If there be four numbers diſpoſed in order, whereof one extreme and the two middle terms are in arithmetical proportion; and the ſame middle terms with the other extreme are in harmonical proportion, the four are in geometrical proportion; as here 2 : 3 : : 4 : 6, which are geometrical; whereof 2, 3, 4, are arithmetical, and 3, 4, 6, harmonical.

6. If betwixt any two numbers you put an arithmetical mean, and alſo an harmonical one, the four will be in geometrical proportion: thus betwixt 2 and 6 an arithmetical mean is 4, and an harmonical one 3; and the four 2 : 3 : : 4 : 6, are geometrical.

We have this notable difference between the three kinds of proportion, arithmetical, harmonical, and geometrical; that from any given number we can raiſe a continued arithmetical ſeries increaſing *in infinitum*, but not decreaſing: the harmonical is decreaſable *in infinitum*, but not increaſable; the geometrical is both.

PROPORTION, or *Rule of Three*. See ARITHMETIC, n° 13, 14, 15.

Reciprocal PROPORTION. See RECIPROCAL.

PROPORTION is alſo uſed for the relation between unequal things of the ſame kind, whereby their ſeveral parts correſpond to each other with an equal augmentation or diminution.

Thus, in reducing a figure into little, or in enlarging it, care is taken to obſerve an equal diminution or enlargement, through all its parts; ſo that if one line, *e. gr.* be contracted by one-third of its length, all the reſt ſhall be contracted in the ſame proportion.

PROPORTION, in architecture, denotes the juſt magnitude of the members of each part of a building, and the relation of the ſeveral parts to the whole; *e. gr.* of the dimenſions of a column, &c. with regard to the ordonnance of a whole building.

One of the greateſt differences among architects, M. Perrault obſerves, is in the proportions of the heights of entablatures with reſpect to the thickneſs of the columns, to which they are always to be accommodated.

In effect, there is ſcarce any work, either of the ancients or moderns, wherein this proportion is not different; ſome entablatures are even near twice as high as others:—yet it is certain this proportion ought of all others to be moſt regulated; none being of greater importance, as there is none wherein a defect is ſooner ſpied, nor any wherein it is more ſhocking.

Compaſs of PROPORTION, a name by which the French, and after them ſome Engliſh, authors call the SECTOR.

PROPORTIONAL, relating to proportion. Thus we ſay, proportional compaſſes, parts, ſcales, ſpirals, &c.

PROPORTIONALS, in geometry, are quantities, either linear or numeral, which bear the ſame ratio or relation to each other.

PROPOSITION, in logic, part of an argument wherein ſome quality, either negative or poſitive, is attributed to a ſubject.

PROPOSITION, in mathematics, is either ſome truth advanced and ſhown to be ſuch by demonſtration, or ſome operation propoſed and its ſolution ſhown. If the propoſition be deduced from ſeveral theoretical definitions compared together, it is called a *theorem*; if from a praxis, or ſeries of operations, it is called a *problem*. See the articles THEOREM and PROBLEM.

PROPOSITION, in oratory. See ORATORY, n° 28. 124.

PROPOSITION, in poetry, the firſt part of a poem, wherein the author propoſes briefly, and in general, what he is to ſay in the body of his work. It ſhould comprehend only the matter of the poem, that is, the action and perſons that act. Horace preſcribes modeſty and ſimplicity in the propoſition, and would not have the poet promiſe too much, nor raiſe in the reader too great ideas of what he is going to relate.

PROPREFECT, among the Romans, the prefect's lieutenant, or an officer whom the perfect of the pretorium commiſſioned to do part of his duty in his place.

PROPRETOR, a Roman magiſtrate, who, having diſcharged the office of pretor at home, was ſent into a province to command there with his former pretorial authority. It was alſo an appellation, given to thoſe who, without having been pretors at Rome, were ſent extraordinarily into the provinces to adminiſter juſtice with the authority of pretors.

PROPRIETOR, or PROPRIETARY, is he who poſſeſſes any thing as his own in the utmoſt degree. Such monks were called *proprietary* as had reſerved goods and effects to themſelves, notwithſtanding their formal renunciation of all at the time of their profeſſion. They are frequently mentioned in the *Monaſt. Anglic.* &c. and were to be very ſeverely dealt with; to be excommunicated, deprived of burial, &c. *Monachi proprietarii excommunicentur ab abbatibus: et, ſi in morte proprietarius inventus fuerit, eccleſiaſtica careat ſepultura*, &c. Addit. ad Matt. Par.

PRO RATA, in commerce, a term ſometimes uſed by merchants for *in proportion*; as each perſon muſt reap the profit or ſuſtain the loſs, *pro rata* to his intereſt, that is, in proportion to his ſtock.

PROROGATION, the act of prolonging, adjourning, or putting off, to another time. The difference between a prorogation and an adjournment of parliament is, that by prorogation the ſeſſion is ended, and ſuch bills as paſſed in either houſe, or both houſes, and had not the royal aſſent, muſt at the next aſſembly begin again.

PROSCRIPTION, a publication made in the name of the chief or leader of a party, whereby he promiſes a reward to any one who ſhall bring him the head of one of his enemies.

Sylla and Marius by turns proſcribed each other's adherents.—Under the triumvirate a great part of the beſt and braveſt of the Romans fell by proſcription.

The term took its riſe from the practice of writing down a liſt of the perſons names, and poſting it in public; from *pro* and *ſcribo* "I write."

PROSE, the natural language of mankind, looſe and unconfined by poetical meaſures, rhymes, &c. In which ſenſe it ſtands oppoſed to verſe.

There is, however, a ſpecies of proſe which is meaſured, ſuch as that in which epitaphs and other inſcriptions are generally written; and indeed every man who has formed for himſelf a ſtyle writes in uniform periods regularly recurring. It has been much diſputed whether a poem can be written in proſe. We enter not into that diſpute, as we have ſaid enough on the ſubject elſewhere. See NOVEL.

The word *proſe* comes from the Latin *proſa*, which ſome will have derived from the Hebrew *poras*, which ſignifies *expendit*: others deduce it from the Latin *prorſa*, of *prorſus*, "going forwards;" by way of oppoſition to *verſa*, or "turning backwards," as is neceſſary in writing.

PROSECUTION, in the criminal law. The next ſtep towards the puniſhment of offenders after COMMITMENT, is their proſecution, or the manner of their formal accuſation. And this, in the Engliſh law, is either upon a previous finding of the fact by an inqueſt or grand jury; or without ſuch previous finding.

The former way is either by PRESENTMENT or INDICTMENT. See theſe articles.

The remaining methods of proſecution are without any previous finding by a jury, to fix the authoritative ſtamp of veriſimilitude upon the accuſation. One of theſe, by the common law, was when a thief was taken *with the mainour*, that is, with the thing ſtolen upon him, *in manu*. For he might, when ſo detected, *flagrante delicto*, be brought into court, arraigned, and tried, without indictment: as by the Daniſh law he might be taken and hanged upon the ſpot without accuſation or trial. But this proceeding was taken away by ſeveral ſtatutes in the reign of Edward III. though in Scotland a ſimilar proceſs remains to this day. So that the only ſpecies of proceeding at the ſuit of the king, without a previous indictment or preſentment by a grand jury, now ſeems to be that of INFORMATION; which ſee.

Theſe are all the methods of proſecution at the ſuit of the king. There yet remains another, which is merely at the ſuit of the ſubject, and is called an APPEAL. See that article.

But of all the methods of proſecution, that by indictment is the moſt general. See INDICTMENT.

PROSECUTOR, in law, he that purſues a cauſe in another's name.

PROSELYTE, a new convert to ſome religion or religious ſect.

PROSERPINACA, in botany: A genus of the trigynia order, belonging to the triandria claſs of plants; and in the natural method ranking under the 15th order, *Inundatæ*. The calyx is tripartite ſuperior; there is no corolla; there is one trilocular ſeed.

PROSERPINE, in fabulous hiſtory, the daughter of Jupiter and Ceres, was carried off by Pluto as ſhe was gathering flowers with her companions. Ceres, diſconſolate for the loſs of her daughter, after having long ſought her, heard where ſhe was, and intreated Jupiter to let her return from hell. This requeſt Jupiter granted, on condition ſhe had taſted nothing in Pluto's dominions. Ceres therefore went to fetch her; but when her daughter was preparing to return, Aſcalaphus gave information that he had ſeen Proſerpine eat ſome grains of a pomegranate ſhe had gathered in Pluto's garden; on which ſhe was ſentenced to continue in Tartarus in quality of Pluto's ſpouſe, and the queen of thoſe gloomy regions: but to mitigate the grief of Ceres for her diſappointment, Jupiter granted that her daughter ſhould only ſpend ſix months together in hell with her huſband, and the other ſix on earth with her mother.

Some mythologiſts imagine that the latter part of the fable alludes to the corn, which muſt remain all the winter hid in the earth, in order to ſprout forth in the ſpring, and produce the harveſt.

PROSEUCHE, in antiquity, properly ſignifies *prayer*; but it is taken for the places of prayer of the Jews, and was pretty near the ſame as their ſynagogues. But the ſynagogues were originally in the cities, and were covered places: whereas, for the moſt part, the proſeuches were out of the cities, and on the banks of rivers; having no covering, except perhaps the ſhade of ſome trees or covered galleries. The word is Greek, προσευχη *prayer*.

PROSLAMBANOMENE, the name of a muſical note in the Greek ſyſtem.

As the two tetrachords of the Greeks were conjunctive, or, in other words, as the higheſt note of the firſt ſerved likewiſe for the loweſt note of the ſecond, it is plain that a complete octave could not be formed. To remedy this deficiency, therefore, one note beneath the loweſt tetrachord was added, as an octave to the higheſt of the laſt tetrachord. Thus, if we ſuppoſe the firſt to have begun on B, the laſt muſt have ended upon A, to which one note ſubjoined immediately beneath the loweſt B in the diatonic order muſt have formed an octave. This note was called *proſlambanomene*. But it appears from authors who have ſcrutinized antiquity with ſome diligence, and perhaps with as much ſucceſs as the data upon which they proceeded could produce, that the names of the notes in the Greek ſyſtem, which originally ſignified their natural ſtation in the ſcale of aſcending or deſcending ſounds, were afterwards applied to their poſitions in the lyre. *Higher* or *lower*, then, according to this application, did not ſignify their degrees of acuteneſs or gravity, but their higher or lower ſituation upon this inſtrument.

Burney's Hiſt. of Muſic, Diſſert. § 1.

PROSODY, that part of grammar which treats of the quantities and accents of ſyllables, and the manner of making verſes.

The Engliſh proſody turns chiefly on two things, numbers and rhyme. See POETRY, nº 66—76. and Part III.

PROSOPIS, in botany: A genus of the monogynia order, belonging to the decandria claſs of plants. The calyx is hemiſpherical and quadridentate; the ſtigma is ſimple; the legumen inflated and monoſpermous.

PROSOPOPŒIA, a figure in oratory, whereby we raiſe qualities of things inanimate into perſons. See ORATORY, p. 539 and 452.

PROSTATÆ, in anatomy, a gland, generally ſuppoſed to be two ſeparate bodies, though in reality but one, ſituated juſt before the neck of the bladder, and ſurrounding the beginning of the urethra. See ANATOMY, p. 738. col. 2.

PROSTYLE, in architecture, a range of columns in the front of a temple.

PROTAGORAS, a famous Greek philoſopher, was born at Abdera. In his youth, his poverty obliged him to ſubmit to the ſervile office of frequently carrying logs of wood from the neighbouring fields to Abdera. It happened, that as he was one day going on briſkly towards the city under one of theſe loads, he was met by Democritus, who was particularly ſtruck with the neatneſs and regularity of the bundle. Deſiring him to ſtop and reſt himſelf, Democritus examined more cloſely the ſtructure of the load, and found that it was put together with mathematical exactneſs; upon which he aſked the youth whether he himſelf had made it up. Protagorus aſſured him that he had; and immediately taking it to pieces, with great eaſe replaced every log in the ſame exact order as before. Democritus expreſſed much admiration of his ingenuity: and ſaid to him, "Young man, follow me, and your talents ſhall be employed upon greater and better things." The youth conſented, and Democritus took him home, maintained him at his own expence, and taught him philoſophy, which qualified him for the office of legiſlator of the Thurians. He was more ſubtile than ſolid in his reaſonings; however, he taught at Athens with great reputation, but was at length

Enfield's Hiſtory of Philoſophy Vol. I.

length baniſhed from thence for the impiety of his doctrines. He then travelled, and viſited the iſlands in the Mediterranean, where it is ſaid that he was the firſt philoſopher who taught for money. He died in a voyage to Sicily, in a very advanced age. He commonly reaſoned by dilemmas, and left the mind in ſuſpenſe with reſpect to all the queſtions, he propoſed. His moral principles were adopted by Hobbes. (See MORAL PHILOSOPHY). Plato wrote a dialogue againſt him. He flouriſhed 400 years B. C.

PROTASIS, in the ancient drama, the firſt part of a comic or tragic piece, wherein the ſeveral perſons are ſhown, their characters intimated, and the ſubject of the piece propoſed and entered upon.

It might reach as far as our two firſt acts; and where it ended the epitaſis commenced. See the article EPITASIS.

PROTEA, the SILVER-TREE: A genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 47th order, *Stellatæ*. There is one quadrifid petal ſurrounding the germ; there is no proper calyx; the receptacle is paleaceous. There are 36 ſpecies, all natives of the Cape of Good Hope; of which the moſt remarkable are, 1. The conifera, with linear, ſpear-ſhaped, entire leaves, grows to the height of 10 or 12 feet, with a ſtraight regular ſtem. The branches naturally form a large regular head. The leaves are long and narrow, of a ſhining ſilver colour; and as they remain the whole year, make a fine appearance in the greenhouſe. 2. The argentea, commonly called *ſilver-tree*, has a ſtrong upright ſtem covered with purpliſh bark, dividing into ſeveral branches which grow erect, garniſhed with broad, ſhining, ſilvery leaves, which make a fine appearance when intermixed with other exotics. Through the whole year it exhibits its gloſſy white or ſilvery leaves. It has at firſt a very uncommon and beautiful appearance, and ſometimes in the courſe of 12 or 15 years reaches the height of 20 feet, which it never exceeds. In a rich ſoil it grows twice as quick, and is by far the largeſt of the protea kind. They are generally planted near ſome farms, and very ſeldom grow wild; Mr Sparman * thinks it was probably brought to the Cape of Good Hope from *Anamaqua*; for he had travelled over the whole north-eaſt ſide of Hottentot's Holland, without finding it either in its wild ſtate or planted. 3. The nitida, or wageboom, greatly reſembles the ſecond ſort: the leaves are very ſilky and white, with erect purple branches.

All theſe plants, being tender exotics, require to be continually kept in the greenhouſe during winter. The firſt may be propagated by cuttings, which ſhould be cut off in April, juſt before the plants begin to ſhoot; the ſecond and third ſorts may be propagated by ſeeds.

PROTECTOR, a perſon who undertakes to ſhelter and defend the weak, helpleſs, and diſtreſſed.

Every Catholic nation, and every religious order, has a protector reſiding at the court of Rome, who is a cardinal, and is called the *cardinal protector*.

Protector is alſo ſometimes uſed for a regent of a kingdom, made choice of to govern it during the minority of a prince.

Cromwell aſſumed the title and quality of *lord protector of the commonwealth of England*, &c.

PROTESILAI TURRIS, the ſepulchre of Proteſilaus, with a temple, at which Alexander ſacrificed, (Arian); ſituated at the ſouth extremity of the Helleſpont, next the Cherſoneſus Thracia. Proteſilaus was the firſt Greek who landed on the coaſt of Troy, and the firſt Greek ſlain by the Trojans, (Homer, Ovid.) His wife Laodamia, to aſſuage her grief, begged the gods for a ſight of his ſhade; and obtaining her requeſt, ſhe expired in his embraces, (Hyginus.) Proteſilaus was alſo called *Phylacides*, from Phylace, a town of Theſſaly.

PROTEST, in law, is a call of witneſs, or an open affirmation that a perſon does, either not at all, or but conditionally, yield his conſent to any act, or to the proceeding of any judge in a court in which his juriſdiction is doubtful or to anſwer upon his oath farther than he is bound by law.

Any of the lords in parliament have a right to proteſt their diſſent to any bill paſſed by a majority: which proteſt is entered in form. This is ſaid to be a very ancient privilege. The commons have no right to proteſt. See PARLIAMENT.

PROTEST, in commerce, a ſummons written by a notary-public to a merchant, banker, or the like, to accept or diſcharge a bill of exchange drawn on him, after his having refuſed either to accept or pay it. See *Bill of Exchange*.

PROTESTANT, a name firſt given in Germany to thoſe who adhered to the doctrine of Luther; becauſe in 1529 they proteſted againſt a decree of the Emperor Charles V. and the diet of Spires; declaring that they appealed to a general council. The ſame name has alſo been given to thoſe of the ſentiments of Calvin; and is now become a common denomination for all thoſe of the reformed churches.

PROTEUS, in heathen mythology. See EGYPT, n° 6.

PROTHONOTARY, a term which properly ſignifies *firſt notary*, and which was anciently the title of the principal notaries of the emperors of Conſtantinople.

Prothonotary, in England, is uſed for an officer in the court of king's bench and common-pleas; the former of which courts has one, and the latter three. The prothonotary of the king's-bench records all civil actions ſued in that court, as the clerk of the crown-office does all criminal cauſes. The prothonotaries of the common pleas enter and enrol all declarations, pleadings, aſſizes, judgments, and actions: they alſo make out all judicial writs, except writs of *habeas corpus*, and *diſtringas jurator*, for which there is a particular office, called the *habeas corpora office*: they likewiſe enter recognizances acknowledged, and all common recoveries; make exemplifications of records, &c.

In the court of Rome there is a college of 12 prelates, called *apoſtolical prothonotaries*, impowered to receive the laſt wills of cardinals, to make all informations and proceedings neceſſary for the canonization of ſaints, and all ſuch acts as are of great conſequence to the Papacy: for which purpoſe they have the right of admiſſion into all conſiſtories, whether public or half public. They alſo attend on the pope, whenever he performs any extraordinary ceremony out of Rome.

PROTO, a Greek term, frequently uſed in compoſition of priority: thus, proto-collum, in the ancient jurisprudence, ſignifies the firſt leaf of a book; protomartyr, the firſt martyr; proto-plaſt, the firſt man formed, &c.

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* Voyage to the Cape of Good Hope, Vol. I. p. 33.

PROTOGENES, a celebrated ancient painter, was born at Caunas, a city of Caria, ſubject to the Rhodians, and flouriſhed 300 years before the birth of our Saviour. He was at firſt obliged to paint ſhips for his livelihood; but afterwards acquired the higheſt reputation for hiſtory-painting; though Appelles blamed him for finiſhing his pieces too highly, and not knowing when to have done. The fineſt of his pictures was that of Jaliſus, which is mentioned by ſeveral ancient authors, though none of them give any deſcription of it. He worked ſeven years on this picture; during which time he lived entirely upon lupines and water, being of opinion that this light and ſimple nouriſhment left him greater freedom of fancy. Apelles, on ſeeing this picture, was ſtruck with ſuch admiration, that he was unable to ſpeak, or to find words ſufficient to expreſs his idea of its beauty. It was this picture that ſaved the city of Rhodes when beſieged by Demetrius king of Macedon; for being able to attack it only on that ſide where Protogenes worked, which he intended to burn, he choſe rather to abandon his deſign than to deſtroy ſo fine a piece. Pliny ſays, that Apelles aſking him what price he had for his pictures, and Protogenes naming an inconſiderable ſum, Apelles, concerned at the injuſtice done to the beauty of his productions, gave him 50 talents, about 10,000 l. for one picture only, declaring publicly that he would ſell it for his own. This generoſity made the Rhodians ſenſible of the merit of Protogenes; and they were ſo eager to purchaſe the picture Apelles had bought, that they paid him a much greater price for it than he had given.

PROTOTYPE, is the original or model after which a thing was formed; but chiefly uſed for the patterns of things to be engraved, caſt, &c.

PROTRACTOR, an inſtrument for laying down and meaſuring angles upon paper with accuracy and diſpatch; and by which the uſe of the line of chords is ſuperſeded. This inſtrument is variouſly formed, as ſemicircular, rectangular, or circular; and conſtructed of different materials, as braſs, ivory, &c. It is neceſſary in laying down thoſe ſurveys or other plans where angles are concerned. For the ſemicircular protractor, and its uſe in laying down and meaſuring angles, ſee GEOMETRY, p. 676. prop. xx. &c.

The rectangular protractor is conſtructed in form of a right-angled parallelogram, which, when applied to a caſe of mathematical inſtruments, is ſubſtituted in place of the ſemicircular protractor and ſcale of equal parts. Fig. 1. is a repreſentation of it: the manner of uſing it is exactly ſimilar to that of the ſemicircular one. Plate cccxviii.

The circular protractor, as its name implies, is a complete circle, and is ſuperior by far to either of the former, both in point of accuracy and diſpatch, eſpecially when ſeveral angles are to be formed at the ſame point. The limb of this inſtrument is divided into 360 degrees, and each degree in ſome protractors is halved: it has a ſubdividing ſcale or vernier, by which an angle may be laid down or meaſured to a ſingle minute. In the centre of the protractor is a fine mark, which, when an angle is to be protracted or meaſured, is to be laid upon the angular point, and 0, or zero on the limb, upon the given line forming one ſide of the angle.

Fig. 2. repreſents a circular protractor whoſe limb is divided as above deſcribed, and the dividing ſcale on the index, which moves round the limb of the protractor on a conical centre, gives every minute of a degree. That part of the index beyond the limb has a ſteel point fixed at the end, in a direct line with the centre of the protractor, and whoſe uſe is to prick off the propoſed angles.

Fig. 3. is another circular protractor, a little differently conſtructed from the former. The central point is formed by the interſection of two lines croſſing each other at right angles, which are cut on a piece of glaſs. The limb is divided into degrees and half degrees, having an index with a vernier graduated to count to a ſingle minute, and is furniſhed with a tooth and pinion, by means of which the index is moved round by turning a ſmall nut. It has two pointers, one at each end of the index, furniſhed with ſprings for keeping them ſuſpended while they are bringing to any angle; and being brought, applying a finger to the top of the pointer, and preſſing it down, pricks off the angle. There is this advantage in having two pointers, that all the bearings round a circuit may be laid or pricked off, although the index traverſes but one half of the protractor.

Another circular protractor, different from either of the former, is repreſented at fig. 4. The centre is alſo formed by the interſection of two lines at right angles to each other, which are cut on glaſs, that all parallax may thereby be avoided. The index is moved round by a tooth and pinion. The limb is divided into degrees and half degrees, and ſubdivided to every minute by the vernier. The pointer may be ſet at any convenient diſtance from the centre, as the ſocket which carries it moves upon the bar BC, and is fixed thereto by the nut D, at right angles to the bar BC, and moveable with it. There is another bar EF: On this bar different ſcales of equal parts are placed; ſo that by moving a ſquare againſt the inner edge thereof, angles may be transferred to any diſtance within the limits, from the centre containing the ſame number of degrees marked out by the index.

It would indeed be ſuperfluous to deſcribe any more of theſe circular protractors, eſpecially as the little alterations in them depend very much upon the fancy of the artiſt. Suffice it however to ſay, that we have ſeen others ſtill differently conſtructed, one of which we ſhall briefly deſcribe. The diviſions upon the limb of this inſtrument are ſimilar to thoſe already deſcribed; but the index is a ſtraight bar continued to ſome conſiderable diſtance each way beyond the limb of the inſtrument, and has a vernier to ſhow minutes as uſual; a mark upon one of the edges of the index always coincides with the centre of the inſtrument. Inſtead, therefore, of pricking down the angle as in the former, part of the line containing the angle may be drawn, which, although perhaps not ſo accurate as a point, is more conſpicuous, and the line is eaſily completed upon removal of the protractor. The common dimenſions of the circular part of theſe inſtruments is from ſix to ten inches diameter; and they are made of braſs.

PROTUBERANCE, in anatomy, is any eminence, whether natural or preternatural, that projects or advances out beyond the reſt.

PROVEDITOR, an officer in ſeveral parts of Italy, particularly at Venice, who has the direction of matters relating to policy.

PROVENCE, a province or government of France, bounded by Dauphine on the north, by Piedmont on the eaſt, by the Mediterranean on the ſouth, and by the river Rhone, which ſeparates it from Languedoc, on the weſt: it is about 100 miles long, and near as many broad.

PROVEND, or PROVENDER, originally ſignified a kind of veſſel containing the meaſure of corn daily given to a horſe, or other beaſt of labour, for his ſubſiſtence; but is now generally uſed to ſignify the food for cattle, whatever it is.

PROVERB, according to Cambden, is a conciſe, witty, and wiſe ſpeech, grounded upon experience, and for the moſt part containing ſome uſeful inſtruction.

Book of PROVERBS, a canonical book of the Old Teſtament, containing a part of the proverbs of Solomon the ſon of David king of Iſrael. The firſt 24 chapters are acknowledged to be the genuine work of that prince; the next five chapters are a collection of ſeveral of his proverbs made by order of king Hezekiah; and the two laſt ſeem to have been added, though belonging to different and unknown authors, Agur the ſon of Jakeh, and king Lemuel.

In this excellent book are contained rules for the conduct of all conditions of life; for kings, courtiers, maſters, ſervants, fathers, mothers, Children, &c.

1 Definition.

PROVIDENCE, the ſuperintendence and care which God exerciſes over creation.

2 Belief of a providence univerſal.

That there exiſts a divine providence which attends to the affairs of this world, and directs their courſe, has been a received opinion among the human race in every country and in every period of hiſtory. Every altar that is erected, every prayer and every ſacrifice that is offered up, affords a proof of this belief. So fully have men been convinced of the ſincerity of each other's faith upon this ſubject, that in one form, that of an appeal to the Divine Ruler of the world, by the ſolemnity of an oath, they have introduced it both into the moſt ordinary and the moſt important buſineſs of life.

3 Exiſtence of providence may be proved on ſcientific principles.

This univerſal conviction of men of all degrees of knowledge, from the moſt profound philoſopher to the rudeſt barbarian, is probably to be traced to ſome primæval tradition, never totally effaced from any nation under heaven. The truth itſelf, however, is ſuſceptible of the moſt complete proof from principles of ſcience. If the world had a beginning, it may obviouſly have an end, and can be continued in exiſtence only by the conſtant energy of that power by which it was at firſt created. He therefore who acknowledges a creation and denies a providence, involves himſelf in this palpable contradiction—"that a ſyſtem, which of itſelf had not an original and momentary exiſtence, may yet of itſelf have a perpetual exiſtence; or that a being which cannot of itſelf exiſt for a ſecond of time, may yet, of itſelf, exiſt for thouſands of years!" Or ſhould we be ſo complaiſant, as for a moment to ſuppoſe, with certain theiſts, ancient and modern, that the *matter* of the univerſe is ſelf-exiſtent and eternal, and that the power of God was exerted, not in creating ſubſtances, but in reducing the original matter from a ſtate of chaos into that beautiful order in which we ſee it arranged; the conſtant energy of providence muſt ſtill be admitted as neceſſary to preſerve the forms and to continue the motions which were originally impreſſed upon the chaotic maſs. From late experiments it appears extremely doubtful whether any two atoms of the moſt ſolid body be in actual contact; and that they are not *all* in contact is certain. (See METAPHYSICS, n° 176. and OPTICS, n° 46, 64, 66.) Yet it requires a very conſiderable degree of force to carry to a greater diſtance from one another the parts of a ſtone or of a bar of iron. By what power then are theſe parts kept contiguous? It cannot be by their own; becauſe nothing can act where it is not preſent, and becauſe our beſt philoſophy has long taught us that the atoms of matter are eſſentially inactive. Again, it requires a very great degree of force to bring two bodies, however ſmall, into *apparent* contact (ſee OPTICS, *ubi ſupra*); and therefore it follows that they muſt be kept aſunder by ſome foreign power. Every attempt to ſolve theſe phenomena by the intervention of a ſubtle fluid is vain; for the queſtion recurs, what keeps the parts of the fluid itſelf contiguous, and yet ſeparated from each other?

The coheſion therefore of the parts of matter, and that which is called their repulſive power, demonſtrate, through the whole ſyſtem, the immediate energy of ſomething which is not matter, and by which every body ſmall and great is preſerved in its proper form. It has been elſewhere ſhown (ſee METAPHYSICS, Part II. chap. 5. and MOTION, n° 19, 20), that the various motions which are regularly carried on through the univerſe, by which animals and vegetables grow and decay, and by which we have day and night, ſummer and winter, cannot be accounted for by any laws of mere mechaniſm, but neceſſarily imply the conſtant agency of ſomething which is itſelf diſtinct from matter. But the forms of bodies are preſerved, and their natural motions carried on, for purpoſes obviouſly planned by Wiſdom. The power therefore which effects theſe things muſt be combined with intelligence: but power and intelligence preſerving the order of the univerſe conſtitute all that is meant by a general providence; which is therefore as certainly adminiſtered as the ſun daily riſes and ſets, or as bodies are kept ſolid by what is termed coheſion and repulſion.

4 Reaſoning of the Bramins of Hindoſtan.

Abſtracted and metaphyſical as this reaſoning may appear, it is by no means peculiar to the philoſophers of Europe. Its force has been felt from time immemorial by the Bramins of Hindoſtan, who, as Sir William Jones informs us*, "being unable to form a diſtinct idea of brute matter independent of mind, or to conceive that the work of ſupreme goodneſs was left a moment to itſelf, imagine that the Deity is ever preſent to his work, not in ſubſtance but in ſpirit and in energy." On this rational and ſublime conception they have indeed built numberleſs abſurd ſuperſtitions; but their holding the opinion itſelf, ſhows that they believe in the reality of providence upon philoſophical principles: and what truth is there on which the mind of man has not ingrafted marks of its own weakneſs?

Few nations, however, except the ancient Greeks, have had philoſophers equally ſubtile with the Bramins of India; and therefore though all mankind have in general agreed in the belief of a ſuperintending Providence, they have in different ages and countries admitted that truth upon different kinds of evidence, and formed very different notions concerning the mode in which the Divine ſuperintendance is exerted.

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* Aſiatic Reſearches, Vol. I.

5 Idea of providence in rude ages.

While ſocieties are ſtill in a rude and unpoliſhed ſtate, while individuals poſſeſs little ſecurity and little leiſure for the exertion of their rational powers, every important or ſingular appearance in nature becomes an object of wonder or of terror. In this ſtate of ignorance, men ſee not the univerſe as it is, a great collection of connected parts, all contributing to form one grand and beautiful ſyſtem. Every appearance ſeems to ſtand alone; they know that it muſt have a cauſe, but what that cauſe is they are ignorant. The phenomena exhibited by nature are ſo complicated and ſo various, that it never occurs to them that it is poſſible for one Being to govern the whole. Hence aroſe the different ſyſtems of polytheiſm that have appeared in the world. Nature was divided into different regions, and a particular inviſible power was aſſigned to each department: one conducted the flaming chariot of the ſun, another wielded the terrible thunderbolt, and others were employed in diffuſing plenty. and introducing the uſeful arts among men. Thus, although the various ſyſtems of polytheiſm in general acknowledged one Supreme Ruler, the father of gods and men, yet they at the ſame time peopled not only the regions above, the air and the heavens, but they alſo filled the ocean and the land, every grove, and every mountain, with active but inviſible natures. Having ariſen from the ſame cauſes, theſe ſyſtems of polytheiſm, which are ſo many hypotheſes concerning Divine providence, are all extremely ſimilar; and we have a very favourable ſpecimen of them in the elegant mythology of Greece and Rome, which gave to every region of nature a guardian genius, and taught men in the deep receſſes of the foreſt, or in the windings of the majeſtic flood, to expect the preſence of protecting and friendly powers. See POLYTHEISM.

6 The doctrine has had opponents in almoſt every age,

Notwithſtanding this univerſal reception, in ſome form or other, of the doctrine of a divine providence, it has in every age met with ſome opponents. The moſt ancient of theſe were Democritus and Leucippus. They denied the exiſtence of a Deity—aſſerted that all things were mechanically neceſſary, and that thought and ſenſe were only modifications of matter. This is atheiſm in the ſtricteſt ſenſe, and the only form of it that has ever been conſiſtently ſupported. Epicurus followed upon the ſame principles; but he rendered the ſyſtem altogether abſurd, by confeſſing the freedom of the human will. To avoid the imputation of atheiſm, he aſſerted the exiſtence of God; but declared that he reſided above the heavens, and interfered not in human affairs. One of his maxims was, that "the bleſſed and immortal Being neither hath any employment himſelf, nor troubles himſelf with others." Maximus Tyrius * juſtly obſerves, that this is rather a deſcription of a Sardanapalus than of a Deity. And ſome of the moraliſts † of antiquity remarked, that they knew many men among themſelves poſſeſſed of active and generous minds, whoſe characters they valued more highly than that of Epicurus's god. Some of the ancients alſo appear to have entertained the following ſtrange notion: They acknowledged the exiſtence of a Supreme and of many inferior deities; but at the ſame time, they ſuppoſed that there is a certain fate which rules over all, and is ſuperior to the gods themſelves. See NECESSITY in Mythology.

The providence exerted by the Author of nature over his works is uſually divided into two branches: a *general*, referring to the management of the univerſe at large; and a *particular* providence, chiefly regarding particular men.

7 General providence.

Upon the firſt of theſe, in *The Religion of Nature delineated*, the queſtion is ſtated ſomewhat in the following manner: The world may be ſaid to be governed, or at leaſt cannot be ſaid to fluctuate fortuitouſly, if there are laws or rules by which natural cauſes act; if the ſeveral phenomena in it ſucceed regularly, and in general the conſtitution of things is preſerved; if there are rules obſerved in the production of herbs, trees, and the like; if the ſeveral kinds of animals are furniſhed with faculties proper to determine their actions in the different ſtations which they hold in the general economy of the world; and, laſtly, if rational beings are taken care of in ſuch a manner as will at laſt agree beſt with reaſon. By the providence of God we ought to underſtand his governing the world by *ſuch* laws as theſe now mentioned: ſo that if there are ſuch, there muſt be a Divine providence.

8 As it reſpects inanimate objects.

With regard to *inanimate objects*, the caſe agrees preciſely with the above ſuppoſition. The whole of that univerſe which we ſee around us is one magnificent and well regulated machine. The world that we inhabit is a large globe, which, conducted by an inviſible power, flies with a rapidity of which we have no conception, through an extent of ſpace which ſets at defiance every power of fancy to embody it into any diſtinct image. A large flaming orb ſtands immoveable in the heavens; around which this, and other worlds of different magnitudes, perform their perpetual revolutions. Hence ariſe the expected returns of day and night, and the regular diverſity of ſeaſons. Upon theſe great operations a thouſand other circumſtances depend. Hence, for example, the vapours aſcend from the ocean, meet above in clouds, and after being condenſed, deſcend in ſhowers to cover the earth with fertility and beauty. And theſe appearances are permanent and regular. During every age ſince men have been placed upon the earth, this aſtoniſhing machine continued ſteadily to perform its complicated operations. Nothing is left to chance. The ſmalleſt bodies are not leſs regular than the largeſt, and obſerve continually the ſame rules of attraction, repulſion, &c. The apparent variations of nature proceed only from different circumſtances and combinations of things, acting all the while under their ancient laws. We ourſelves can calculate the effects of the laws of gravitation and of motion. We can render them ſubſervient to our own purpoſes, with entire certainty of ſucceſs if we only adhere to the rules eſtabliſhed by nature, that is to ſay, by providence.

9 Vegetables.

Vegetables alſo live and flouriſh according to preſcribed methods. Each ſort is produced from its proper ſeed; has the ſame texture of fibres, is at all times nouriſhed by the *ſame* kind of juices, digeſted and prepared by the *ſame* veſſels. Trees and ſhrubs receive annually their peculiar liveries, and bear their proper fruits: ſo regular are they in this laſt reſpect, that every ſpecies may be ſaid to have its profeſſion or trade appointed

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* Max. Tyr. Diſſert. 29.

† Cicero de finibus, lib. I. and De Natura Deorum, lib. 2.

pointed to it, by which it furniſhes a certain portion of manufacture, or of food, to ſupply the wants of animals: being created for the purpoſe of conſumption, all vegetables produce great quantities of ſeed to ſupply the neceſſary waſte. Here, too, then, there is evidently a *regulation* by which the ſeveral orders are preſerved, and the ends of them anſwered according to their firſt eſtabliſhment.

10 Animals,

With regard to *animals*, they too, in ſtructure of their form, are ſubject to laws ſimilar to thoſe which govern the vegetable world. In the ſentient part of their conſtitution they are no leſs ſubject to rule. The lion is always fierce, the fox is crafty, and the hare is timid. Every ſpecies retains from age to age its appointed place and character in the great family of nature. The various tribes are made and placed in ſuch a manner as to find proper means of ſupport and defence. Beaſts, birds, fiſhes, and inſects, are all poſſeſſed of organs and faculties adapted to their reſpective circumſtances, and opportunities of finding their proper food and prey.

11 And man.

Man is ſubject to the ordinary laws which other material and animal ſubſtances obey; but he is left more at large in the determination of his actions. Yet even here things do not fluctuate at random. Individuals do indeed riſe and periſh according to fixed rules, and nations themſelves have only a temporary endurance. But the ſpecies advances with a ſteady progreſs to intellectual improvement. This progreſs is often interrupted; but it appears not to be leſs ſure at the long-run than even the mechanical laws which govern the material part of our conſtitution. Amidſt the convulſion of ſtates and the ruin of empires, the uſeful arts, when once invented, are never loſt. Theſe, in better times, render ſubſiſtence eaſy, and give leiſure for reflection and ſtudy to a greater number of individuals. Tyre and Sydon have paſſed away, Athens itſelf has become the prey of barbarians, and the proſperity of ancient Egypt is departed, perhaps for ever; but the ſhip, the plow, and the loom, remain, and have been perpetually improving. Thus every new convulſion of ſociety does leſs miſchief than the laſt; and it is hoped that by the aſſiſtance of printing the moſt poliſhed arts and the moſt refined ſpeculations have now become immortal.

The world is not then left in a ſtate of confuſion: it is reduced into order, and methodiſed for ages to come; the ſeveral ſpecies of beings having their offices and provinces aſſigned them. Plants, animals, men, and nations, are in a ſtate of continual change; but ſucceſſors are appointed to relieve them, and to carry on the *ſcheme of Providence*.

12 Difficulty of accounting for particular providence,

But the great difficulty is, how to account for that providence which is called *particular:* For rational beings, and free agents, are capable of doing and deſerving well or ill; and the ſafety or danger, that happineſs or unhappineſs, of a man here, muſt depend upon many things that ſeem ſcarcely *capable* of being determined by Providence. Beſides *himſelf* and his own conduct, he depends upon the conduct of *other men*; whoſe actions, as we naturally ſuppoſe, cannot, conſiſtently with their free will, be controuled for the advantage of another individual. The actions of numbers of men proceeding upon their private freedom, with different degrees of ability, as they croſs and impede, or directly oppoſe each other, muſt produce very different effects upon men of different characters, and thus in a ſtrange manner embarraſs and entangle the general plan. And as to the *courſe of nature*, it may juſtly be aſked, is the force of gravitation to be ſuſpended till a good man paſs by an infirm building? (See Prayer.) Add to this, that ſome circumſtances appear abſolutely irreconcileable. The wind which carries one into port drives another back to ſea; and the rains that are juſt ſufficient upon the hills may drown the inhabitants of the valleys. In ſhort, may we expect *miracles?* or can there be a particular Providence that foreſees and prepares for the ſeveral caſes of individuals, without force frequently committed upon the laws of nature and the freedom of intelligent agents?

13 No good argument againſt its exiſtence.

In whatever way it is brought about, there is little doubt that ſomething of this kind *muſt* take place. For as the Deity *does* direct, as already mentioned, the great and general progreſs of things in this world, he muſt alſo manage thoſe of leſs importance. Nations are compoſed of individuals. The progreſs of individuals is the progreſs of the nation, and the greateſt events uſually depend upon the hiſtory and the moſt trifling actions of private perſons. The difficulty is to conceive how the ſuperintendance and management of all this can be brought about. But as the ways and the thoughts of the Omnipotent Spirit, whoſe influence pervades, and rules, and animates nature, reſemble not the limited operations of men, we can only form conjectures concerning the means by which his government is conducted.

14 The Deity may eaſily foreſee the actions of men;

1. In the firſt place, then, it is not impoſſible that the Deity ſhould foreſee the future actions of intelligent beings. Many of theſe actions depend upon the mechaniſm of the material world, which was formed by himſelf, and muſt be entirely known to him. Many men among ourſelves poſſeſs much ſagacity in diſcerning the future actions of others, from attending to their known characters, and the circumſtances in which they are placed. If ſuperior natures do exiſt, and minds more perfect than the human, they muſt poſſeſs this penetration in a more eminent degree in proportion to the excellence of their intellectual powers. But if this diſcernment be in God proportionable to his nature, as in lower beings it is proportionable to theirs, it then becomes altogether unlimited, and the future actions of free agents are at once unlocked and expoſed to his view. Add to this, that the Author of nature is well acquainted with the creatures that he has made; he knows the mechaniſm of our bodies, the nature and extent of our underſtandings, and all the circumſtances by which we are ſurrounded. With all theſe advantages, it is making no great ſtretch to ſuppoſe him capable of diſcerning the line of conduct which we will purſue; and this even ſetting aſide the infinity of his nature, to which a thouſand years are as one day, and ſuppoſing him to reaſon from probabilities in the imperfect manner that we do.

15 And may thence fit them for their ſituations in life.

2. There is no impoſſibility at leaſt, that men, whoſe characters and actions are thus foreknown, may be introduced into the world in ſuch times and places as that their acts and behaviour may not only coincide with the general plan of things, but may alſo anſwer many private caſes. The celeſtial bodies are ſo placed that their jarring attractions make out a ſplendid ſyſtem.

Why then may there not be in the Divine mind ſomething like a projection of the future hiſtory of mankind, as well as of the motions of the heavenly bodies? And why ſhould it not be thought poſſible for men, as well as for them, by ſome ſecret law, or rather by the management of an unſeen power, to be brought into their places in ſuch a manner as that, by the free uſe of their faculties, the conjunctions and oppoſitions of their intereſts and inclinations, the natural influence of their different degrees of talents, power, and wealth, they may conſpire to make out the great ſcheme of human affairs? There is no abſurdity in this ſuppoſition: it is not beyond the power of an almighty and perfect Being; and it is worthy of him. Let us take from the Jewiſh hiſtory, as moſt generally known, an example of what may be ſuppoſed to happen daily. It was the intention of providence to place David the ſon of Jeſſe upon the throne of the Hebrews. The country is invaded by a foreign enemy: the hoſtile armies meet, and lie encamped upon oppoſite mountains. A man comes forth from the army of the invaders, as was extremely common in thoſe times, and defies the Hebrew hoſt to ſend forth a champion to meet him in ſingle combat. Terrified by the gigantic bulk and mighty force of Goliah, no man would riſk the unequal conflict. David, who was too young to carry arms, had been ſent to the camp with proviſions for his brothers, and heard the challenge. In defence of his flock he had killed ſome beaſts of prey in the wilderneſs, and he was an excellent markſman with the ſling. He thought it might probably be as eaſy to kill a man as a wild beaſt; at all events, he knew that a ſtone well directed would prove no leſs fatal to a giant than to a dwarf: he therefore reſolved to try his ſkill; and he tried it with ſucceſs. Here no man's free will was interrupted, and no miracle was accompliſhed: Yet by this *train* of circumſtances thus *brought* together, a foundation was laid for the future fortunes of the ſon of Jeſſe, for the greatneſs of his country, and for accompliſhing the purpoſes of Providence. According to Seneca, "Hoc dico, fulmina non mitti a Jove, ſed ſic omnia diſpoſita, ut ea etiam quæ ab illo non fiunt, tamen ſine ratione non fiunt: quæ illius eſt.—Nam etſi Jupiter illa nunc non facit, facit ut fierent."—*I ſay, that the lightning comes not directly from the hand of Jove, but things are properly diſpoſed for the indirect execution of his will; for he acts not immediately, but by the intervention of means.*

16
The poſſibility of this exemplified.

17
Secret influences on the mind are far from impoſſible.

3. Laſtly, it is *not impoſſible* that many things may be accompliſhed by ſecret influence, upon the human mind, either by the Deity himſelf, or by the intervention of agents poſſeſſed of powers ſuperior to thoſe which belong to us. "For inſtance, if the caſe ſhould require that a particular man be delivered from ſome threatening *ruin*, or from ſome *misfortune*, which would certainly befal him if he ſhould go ſuch a way at ſuch a time, as he intended: upon this occaſion ſome *new* reaſons may be preſented to his mind why he ſhould not go *at all*, or not *then*, or not *by that road*; or he may forget to go. Or, if he is to be delivered from ſome dangerous *enemy*, either ſome new turn given to his thoughts may divert him from going where the *enemy* will be, or the enemy may be after the ſame manner diverted from coming where *he* ſhall be, or his reſentment may be *qualified*; or ſome proper method of *defence* may be ſuggeſted to the perſon in danger. After the ſame manner advantages and ſucceſſes may be conferred on the deſerving; as, on the other ſide, men, by way of puniſhment for their crimes, may incur miſchiefs and calamities. Theſe things, and ſuch as theſe (ſays Mr Wollaſton*), *may be*. For ſince the motions and actions of men, which depend upon their wills, do alſo depend upon their judgments, as theſe again do upon the *preſent appearances* of things in their minds; if a new proſpect of things can be any way produced, the lights by which they are ſeen *altered*, new forces and directions impreſſed upon the ſpirits, paſſions *exalted* or *abated*, the power of judging *enlivened* or *debilitated*, or the attention taken off without any ſuſpenſion or alteration of the ſtanding laws of nature,—then, without that, *new* volitions, deſigns, meaſures, or a ceſſation of thinking, may alſo be produced; and thus many things prevented that otherwiſe would *be*, and many brought about that would *not*. That there may poſſibly be ſuch inſpirations of new thoughts and counſels (continues our author), may perhaps appear farther from this, that we frequently find thoughts ariſing in our heads, into which we are led by no diſcourſe, nothing we read, no clue of reaſoning, but they ſurpriſe and come upon us from we know not what quarter. If they proceeded from the mobility of ſpirits ſtraggling out of order, and fortuitous affections of the brain, or were they of the nature of *dreams*, why are they not as wild, incoherent, and extravagant as they are?" Is it not much more reaſonable to imagine that they come by the order and direction of an all-ſeeing and all-gracious God, who continually watches over us, and diſpoſes every thing in and about us for the good of ourſelves or others? not to ſpeak of the agreeableneſs of this notion to the opinions of the beſt and wiſeſt men in all ages (A). "If this, then, be the caſe, as it ſeems to be, that men's minds are ſuſceptible of ſuch *inſinuations* and *impreſſions*, as frequently, by ways unknown, do affect them, and give them an inclination towards this or that; how many things (aſks our author) may be brought to paſs by theſe means without *fixing* and *refixing* the laws of nature, any more than they are unfixed when one man alters the opinion of another by throwing in his way a book proper for that purpoſe?"

18
And may be effected by beings ſuperior to us, or by the Deity.

All this may be effected either by the immediate interpoſition of God himſelf, or by that of beings *inviſible*, and in nature ſuperior to us, who act as the miniſters of his providence. That there are ſuch beings we can hardly doubt, as it is in the higheſt degree improbable that ſuch imperfect beings as men are at the top of the ſcale of created exiſtence. And ſince we ourſelves, by the uſe of our limited powers, do often alter the courſe

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* Religion of Nature delineated, ſect. 5.

(A) That ſuch was the general belief of the Greeks in the days of Homer, is plain from that poet's conſtantly introducing his deities into the narrative of his poems, and telling us that Minerva, or ſome other god, altered the minds of his heroes. "By this," ſays Plutarch, "the poet does not mean to make God *deſtroy* the will of man, but only move him to will: nor does he miraculouſly produce the appetites themſelves in men, but only cauſes ſuch imaginations as are capable of exciting them."

of things within our ſphere from what they would be if leſt to the ordinary laws of motion and gravitation, without being ſaid to alter thoſe laws; why may not ſuperior beings do the ſame as inſtruments of divine providence? This idea of the intervention of ſuperior natures is beautifully illuſtrated by Thomſon in the following paſſage:

Theſe are the haunts of meditation, theſe
The ſcenes where ancient bards th' inſpiring breath,
Ecſtatic, felt; and from this world retir'd,
Convers'd with angels and immortal forms,
On gracious errands bent: to ſave the fall
Of virtue ſtruggling on the brink of vice;
In waking whiſpers, and repeated dreams,
To hint pure thought, and warn the favoured ſoul
For future trials fated to prepare.

We agree, however, with Mr Wollaſton, in thinking the power of theſe beings not ſo large as to alter or ſuſpend the general laws of nature (ſee MIRACLE); for the world is not like a bungling piece of clock-work, which requires to be often ſet backwards or forwards. We are likewiſe perfectly ſatisfied, that they cannot change their condition, to ape us or inferior beings; and conſequently we are not apt haſtily to credit ſtories of *portents*, &c. ſuch as cannot be true, unleſs the nature of things and their manner of exiſtence were occaſionally reverſed. Yet as men may be ſo placed as to become, even by the free exerciſe of their own powers, *inſtruments* of God's particular providence to other men; ſo may we well ſuppoſe that theſe higher beings may be ſo *diſtributed* through the univerſe, and ſubject to ſuch an economy, unknown to us, as may render *them alſo* inſtruments of the ſame providence; and that they may, in proportion to their greater abilities, be capable, *conſiſtently with the laws of nature*, of influencing human affairs in proper places.

19
Objections to the doctrine of providence.

We ſhall next proceed to ſtate ſome of the chief objections which in ancient or modern times have been brought againſt the opinion, that the world is governed by a Divine providence.

20
From the imperfections of nature.

1. The firſt of theſe is this, that the ſyſtem of nature contains many imperfections which it ought not to do if it be the work of a perfectly wiſe and good Being. To avoid the force of this objection, ſome modern writers have deſerted the ground of ſupreme and abſolute goodneſs, which the ancient theiſts always occupied, and have aſſerted that the divine perfection conſiſts in unlimited power and uncontrouled ſupremacy of will; that conſequently the Deity does not always that which is beſt, but merely what he himſelf pleaſes; and that for no other reaſon but becauſe he *wills* to do ſo. But this is no better than atheiſm itſelf. For it is of no importance to us whether the univerſe is governed by blind fate or chance, that is to ſay, by nothing at all; or whether it is governed by an arbitrary ſovereign will that is directed by chance, or at leaſt by no principle of beneficence.

21
Anſwered.

The true anſwer to this objection is, that no created ſyſtem can have every perfection, becauſe it muſt neceſſarily be deſtitute of ſelf-exiſtence and independence; and therefore if beings deſtitute of ſome perfections be better than nothing, it was worthy of infinite power and perfect goodneſs to create ſuch beings. In our preſent ſtate, we mortals ſtand upon too low ground to take a commanding view of the whole frame of things. We can only reaſon concerning what is unknown from the little that is within our reach. In that little, we can ſee that wiſdom and goodneſs reign; that nature always aims to produce perfection; that many ſalutary effects reſult even from the thunder and the ſtorm: and we doubt not that a view of the whole ſtructure of the univerſe would afford an additional triumph to the goodneſs and ſkill of its great Architect.

We ſee a regular aſcent in the ſcale of beings from mere lifeleſs matter up to man; and the probability is, that the ſcale continues to aſcend as far above men in perfection as created beings can poſſibly be raiſed.—The ſole purpoſe of God in creating the world muſt have been to produce happineſs: but this would be moſt effectually done by creating, in the firſt place, as many of the moſt perfect claſs of beings as the ſyſtem could contain; and afterwards other claſſes leſs and leſs perfect, till the whole univerſe ſhould be completely full. We do not poſitively aſſert ſuch a ſcheme of creation,

Where all muſt full, or not coherent be;
And all that riſes, riſe in due degree,

was actually in the divine Architect's intention; but that it is poſſible, is ſufficiently obvious. No man will pretend to ſay, that this earth could afford a comfortable ſubſiſtence to a greater number of the human race, were all the inferior animals annihilated, than it could at preſent, ſwarming as every element is with life.—Suppoſe then, that as many men had been placed at firſt upon the earth as it could poſſibly ſupport, and that matters had been ſo conſtituted, as that the number ſhould never have been either increaſed or diminiſhed; we beg leave to aſk, whether, ſince there would have been evidently room for inferior animals, it would have been moſt worthy of infinite goodneſs to leave the whole globe to men, or to introduce into it different orders of leſs perfect beings, which, while they could not incommode this principal inhabitant, would each find pleaſure in its own exiſtence? To this queſtion different anſwers cannot ſurely be given. Let the reader then extend his view, and conſider the univerſe, which, however vaſt, cannot be poſitively infinite, as one ſyſtem as much united as the ſeveral parts of this globe; let him ſuppoſe that there were at firſt created as many of the higheſt order of beings as it could have contained had creation there ſtopt; let him remember that happineſs in many different degrees is valuable;—and he will not ſurely think it any imputation on the goodneſs of God that there are in the univerſe many beings far from perfection. The moſt imperfect of theſe are by themſelves better than nothing; and they all contribute to make up a ſyſtem which, conſidered as a whole, we have every reaſon to believe to be as perfect as any thing not ſelf-exiſtent can poſſibly be.

22
Objection from the introduction of evil.

2. If the world is conducted by a benevolent providence, how came evil to be introduced into it? This queſtion has perplexed mankind in all ages. The ancient Perſians reſolved it, by aſſerting the exiſtence of two gods, Oromaſdes the author of good, and Arimanius the author of evil. From them the Chriſtian heretics called *Manichees* borrowed their doctrine of two

oppoſite co-eternal principles. Both the Platoniſts and Stoics aſcribed the origin of evil to the perverſeneſs or imperfection of matter, which they thought the Deity could not alter; and Pythagoras imagined a ſtate of pre-exiſtence, in which the ſouls of men had committed offences, for which they are here ſuffering the puniſhment. But theſe hypotheſis are, ſome of them impious, and all unſatisfactory.

23 Anſwered.

Taking the expreſſion in its moſt extenſive ſenſe, the evils to which the human race are expoſed may be reduced to *pain*, *uneaſineſs*, *diſappointment of appetites*, and *death*; of which not one could have been wholly prevented without occaſioning greater evils, inconſiſtent with the perfect goodneſs of the Creator. As long as we have ſolid bodies capable of motion, ſupported by food, ſubject to the influence of the atmoſphere, and diviſible, they muſt neceſſarily be liable to diſſolution or death: But if a man could ſuffer death, or have his limbs broken, without feeling pain, the human race had been long ago extinct. A fever is a ſtate of the body in which the fluids are in great diſorder. Felt we no uneaſineſs from that diſorder, we ſhould have no inducement to pay the proper attention to our ſtate, and ſhould certainly die unawares, without ſuſpecting ourſelves to be in danger; whereas, under the preſent adminiſtration of divine providence, the pain and ſickneſs of the diſeaſe compel us to have recourſe to the remedies proper for reſtoring us to ſoundneſs and to health. Of the uneaſineſſes to which we are liable, and which are not the effect of immediate pain, the greateſt has been ſometimes ſaid to ariſe from the apprehenſion of death, which conſtantly ſtares us in the face, and frequently embitters all our pleaſures even in the hour of perfect health.—But this dread of death is implanted in our breaſts for the very beſt of purpoſes. Had we no horror at the apprehenſion of death,, we ſhould be apt, whenever any misfortune befel us, to quit this world raſhly, and ruſh unprepared into the preſence of our Judge: but the horror which attends our reflections on our own diſſolution, ariſing not from any apprehenſions of the pain of dying, but from our anxiety concerning our future ſtate of exiſtence, tends ſtrongly to make us act, while we are here, in ſuch a manner as to enſure our happineſs hereafter. Add to this, that the fear of death is the greateſt ſupport of human laws. We every day ſee perſons breaking through all the regulations of ſociety and good life, notwithſtanding they know death to be the certain conſequence, and feel all the horrors of it that are natural to man: and therefore were death diveſted of theſe horrors, how inſignificant would capital puniſhments be as guardians of the law, and how inſecure would individuals be in civil ſociety?

With regard to the unavoidable misfortunes and anxieties of our preſent ſtate, ſo far from being truly hurtful in themſelves, they are proofs of divine beneficence. When we ſee men diſpleaſed with their ſituation, when we hear them complain of the difficulties, the miſeries, and the cares of life, of the hardſhips which they have undergone, and the labours which ſtill lie before them; inſtead of accounting them unfortunate, we ought to regard them as active beings, placed in the only ſituation that is fit for the improvement of their nature. That diſcontent, theſe reſtleſs wiſhes to improve their condition, are ſo many ſure indications that their faculties will not languiſh. They who are in the leaſt degree accuſtomed to obſerve the human character, know well the influence which pleaſure and repoſe have in enfeebling every manly principle, and how capable they are of attaching us even to a ſordid and diſhonourable exiſtence.

Happy indeed it is for the human race, that the number of thoſe men is ſmall whom providence has placed in ſituations in which perſonal activity is unneceſſary. By far the greater number are compelled to exert themſelves, to mix and to contend with their equals, in the race of fortune and of honour. It is thus that our powers are called forth, and that our nature reaches its higheſt perfection. It is even perhaps a general truth, that they who have ſtruggled with the greateſt variety of hardſhips, as they always acquire the higheſt energy of character, ſo if they have retained their integrity, and have not ſunk entirely in the conteſt, ſeldom fail to ſpend their remaining days reſpectable and happy, ſuperior to paſſion, and ſecured from folly by the poſſeſſion of a wiſdom dearly earned.

24 Phyſical evil the cauſe of moral good.

But the benefits of phyſical evils have been ſet in a ſtill ſtronger light by a great maſter of moral wiſdom, who was himſelf ſubject to many of thoſe evils. That man is a moral agent, ſent into this world to acquire habits of virtue and piety to fit him for a better ſtate, is a truth to which no conſiſtent theiſt will for a moment refuſe his aſſent. But almoſt all the moral good which is left among us, is the apparent effect of phyſical evil.

Johnſon's Idler, n° 89.

“Goodneſs is divided by divines into ſoberneſs, righteouſneſs, and godlineſs. Let it be examined how each of theſe duties would be practiſed if there were no phyſical evil to enforce it.

“Sobriety or temperance is nothing but the forbearance of pleaſure; and if pleaſure was not followed by pain, who would forbear it? We ſee every hour thoſe in whom the deſire of preſent indulgence overpowers all ſenſe of paſt, and all foreſight of future miſery. In a remiſſion of the gout, the drunkard returns to his wine, and the glutton to his feaſt; and if neither diſeaſe nor poverty were felt or dreaded, every one would ſink down in idle ſenſuality, without any care of others, or of himſelf. To eat and drink, and lie down to ſleep, would be the whole buſineſs of mankind.

“Righteouſneſs, or the ſyſtem of ſocial duty, may be ſubdivided into juſtice and charity. Of juſtice, one of the heathen ſages has ſhown, with great acuteneſs, that it was impreſſed upon mankind only by the inconveniences which injuſtice had produced. ‘In the firſt ages (ſays he) men acted without any rule but the impulſe of deſire; they practiſed injuſtice upon others, and ſuffered it from others in their turn: but in time it was diſcovered, that the pain of ſuffering wrong was greater than the pleaſure of doing it; and mankind, by a general compact, ſubmitted to the reſtraint of laws, and reſigned the pleaſure to eſcape the pain.’

“Of charity, it is ſuperfluous to obſerve, that it could have no place if there were no want; for of a virtue which could not be practiſed, the omiſſion could not be culpable. Evil is not only the occaſional but the efficient cauſe of charity; we are incited to the relief of miſery by the conſciouſneſs that we have the ſame nature with the ſufferer; that we are in danger of the ſame diſtreſſes, and may ſometime implore the ſame aſſiſtance.

“ Godlineſs or piety is elevation of the mind towards the Supreme Being, and extenſion of the thoughts of another life. The other life is future, and the Supreme Being is inviſible. None would have recourſe to an inviſible power, but that all other ſubjects had eluded their hopes. None would fix their attention upon the future, but that they are diſcontented with the preſent. If the ſenſes were feaſted with perpetual pleaſure, they would always keep the mind in ſubjection. Reaſon has no authority over us but by its power to warn us againſt evil.

“ In childhood, while our minds are yet unoccupied, religion is impreſſed upon them; and the firſt years of almoſt all who have been well educated are paſſed in a regular diſcharge of the duties of piety: But as we advance forward into the crowds of life, innumerable delights ſolicit our inclinations, and inumerable cares diſtract our attention. The time of youth is paſſed in noiſy frolics; manhood is led on from hope to hope, and from project to project; the diſſoluteneſs of pleaſure, the inebriation of ſucceſs, the ardour of expectation, and the vehemence of competion, chain down the mind alike to the preſent ſcene: nor is it remembered how ſoon this miſt of trifles muſt be ſcattered, and the bubbles that float upon the rivulet of life be loſt for ever in the gulph of eternity. To this conſideration ſcarce any man is awakened but by ſome preſſing and reſiſtleſs evil; the death of thoſe from whom he derived his pleaſures, or to whom he deſtined his poſſeſſions, ſome diſeaſe which ſhows him the vanity of all external acquiſitions, or the gloom of age which intercepts his proſpects of long enjoyment, forces him to fix his hopes upon another ſtate; and when he has contended with the tempeſts of life till his ſtrength fails him, he flies at laſt to the ſhelter of religion.

“ That miſery does not make all virtuous, experience too certainly informs us; but it is no leſs certain, that of what virtue there is, miſery produces far the greater part. Phyſical evil may be therefore endured with patience, ſince it is the cauſe of moral good; and patience itſelf is one virtue by which we are prepared for that ſtate in which evil ſhall be no more.”

25 Objection from the permiſſion of moral guilt.

The calamities and the hardſhips of our preſent ſtate, then, are ſo far from being real evils, of which providence ought to be accuſed, that in every point of view in which we can conſider them, they afford the ſureſt proofs of the wiſdom of its adminiſtration, and of its goodneſs to man.

The moſt ſerious difficulty lies in accounting for the permiſſion of moral evil or guilt, in a ſyſtem governed by infinite benevolence and wiſdom. Thoſe who in a conſiſtent manner hold the doctrine of the abſolute neceſſity of human actions in its full extent and acknowledge all its conſequences, find it eaſy to elude this difficulty. They very fairly deny the exiſtence of any ſuch thing as moral evil in the abſtract; and aſſert, that what we call a *crime*, is nothing more than an action which we always regard with a painful ſenſation: that theſe apparent evils endure only for a time; and that all will at laſt terminate in the perfection and happineſs of every intelligent being.

26 Anſwered.

Upon the ſyſtem of liberty, the ſhorteſt anſwer ſeems to be this: that ſome things are abſolutely impoſſible, not from any weakneſs in the Deity, but becauſe they infer abſurdity or contradiction. Thus it is impoſſible for twice two to be any thing elſe than four; and thus it is impoſſible for Omnipotence itſelf to confer ſelf-approbation upon an intelligent being who has never deſerved it; that is to ſay, it is impoſſible for a man of ſenſe to be pleaſed with himſelf for having done a certain action, while he himſelf is conſcious that he never did that action. But ſelf-approbation conſtitutes the higheſt, the moſt unmingled, and permanent felicity, of which our nature is capable. It is not in the power of Omnipotence itſelf, then, to beſtow the higheſt and moſt permanent felicity of our nature; it muſt be *earned* and deſerved before it can be obtained. In the ſame manner good deſert, virtue or merit, cannot be *conferred;* they muſt be *acquired.* To enable us to acquire theſe, we muſt be expoſed to difficulties, and muſt ſuffer in a certain degree. If theſe difficulties had no influence upon our conduct and feelings, if they expoſed us to no real danger, no fabric of merit and of ſelf-approbation could be reared upon them. All that the Supreme Being could do for us, was to confer ſuch an original conſtitution and character as would enable us to do well if we ſhould exert our utmoſt powers. The univerſe is not ruled by favour, but by juſtice. Complete felicity muſt be purchaſed. Guilt is an abuſe of our freedom, a doing ill where we could have done well, and is entirely the work of man. Heaven could not avoid permitting its exiſtence, and expoſing us to danger; for temptation is neceſſary to virtue, and virtue is the perfection of our nature, our glory, and our happineſs.

27 By Simplicius.

The permiſſion of moral evil has been ſo ably accounted for by Simplicius, a Pagan writer, and therefore not biaſſed by any partiality to the Jewiſh or Chriſtian Scriptures, that we cannot deny ourſelves the pleaſure of laying his reaſoning before our readers. He aſks *, “ Whether God may be called the author of ſin, becouſe he permits the ſoul to uſe her liberty? and anſwers the queſtion thus:

“ He who ſays that God ſhould not permit the exerciſe of its freedom to the ſoul, muſt affirm one of theſe two things; either that the ſoul, though by nature capable of indifferently chooſing *good* or *evil,* ſhould yet be conſtantly prevented from chooſing evil; or elſe that it ſhould have been made of ſuch a nature as to have no *power* of chooſing *evil.*

“ The former aſſertion (continues he) is irrational and abſurd; for what kind of liberty would that be in which there ſhould be no freedom of choice? and what choice could there be, if the mind were conſtantly reſtrained to one ſide of every alternative? With reſpect to the ſecond aſſertion, it is to be obſerved (ſays he), that no evil is in itſelf deſirable, or can be choſen *as evil.* But if this power of determining itſelf either way in any given caſe muſt be taken from the ſoul, it muſt either be as ſomething not good, or as ſome great evil. But whoever ſaith ſo, does not conſider how many things there are which, though accounted good and deſirable, are yet never put in competition with this freedom of will: for without it we ſhould be on a level with the brutes; and there is no perſon who would rather be a brute than a man. If God then ſhows his goodneſs in giving to inferior beings ſuch perfections as are far below this, is it incongruous to the divine nature and goodneſs to give man a ſelf-determining power over his actions, and to permit him the free exerciſe of that power? Had God, to prevent man's ſin, taken away the liberty of his will, he would likewiſe have deſtroyed the foundation of all virtue, and the very nature of man; for there could be no virtue were there not a poſſibility of vice; and man's nature, had it continued rational, would have been divine, becauſe impeccable. Therefore (continues he), though we attribute to God, as its author, this ſelf-determining power, which is ſo neceſſary in the order of the univerſe; we have no reaſon to attribute to him that evil which comes by the abuſe of liberty: For God doth not cauſe that averſion from good which is in the ſoul when it ſins; he only gave to the ſoul ſuch a power as might turn itſelf to evil, out of which he produces much good, which, without ſuch a power, could not have been produced by Omnipotence itſelf." So conſonant to the doctrine of our ſcriptures is the reaſoning of this opponent of the writings of Moſes! *Fas eſt et ab hoſte doceri.*

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* Simplic. Com. in Epict. pag. 186. 187. ed. Salmoſ.

28 Objection from the apparent confuſion of human affairs, The laſt objection to the belief of a divine providence ariſes from the apparent confuſion of human affairs, that all things happen alike to all, that bad men are proſperous, and that a total want of juſtice appears to attend the divine adminiſtrations. Even the beſt men have at times been ſhaken by this conſideration.—But there are many reaſons for rendering this world a mixed ſcene: it would become unfit for a ſtate of trial, and of education to virtue were it otherwiſe.

29 Anſwered. It has been ſhown already, that phyſical evil is the parent of moral good; and therefore it would be abſurd to expect that the virtuous ſhould be entirely exempted from that evil. For the occaſional proſperity of the wicked, many reaſons have been aſſigned even by thoſe who, in their diſquiſitions, were not guided by that revelation which has brought to light life and immortality. 30 By Plutarch. "God (ſays Plutarch) ſpares the wicked, that he may ſet to mankind an example of forbearance, and teach them not to revenge their injuries too haſtily on each other. He ſpares ſome wicked men from early puniſhment, in order to make them inſtruments of his juſtice in puniſhing others. And he ſpares all for a time, that they may have leiſure for repentance; for men (ſays the ſame excellent moraliſt) look at nothing further, in the puniſhments which they inflict, than to ſatisfy their revenge and malice, and therefore they purſue thoſe who have offended them with the utmoſt rage and eagerneſs; whereas God, aiming at the cure of thoſe who are not utterly incurable, gives them μεταϐαλλεσθαι χρονος, "time to be converted."

But this objection receives the beſt ſolution from the doctrine of the immortality of the human ſoul.

31 The immortality of the ſoul the beſt anſwer to this objection.

————And ſee!
'Tis come, the glorious morn! the ſecond birth
Of heav'n and earth! awakening nature hears
The *new creating word*, and ſtarts to life,
In every height'ned form, from pain and death
For ever free. *The great eternal ſcheme*,
Involving all, and in a *perfect whole*
Uniting, as the proſpect wider ſpreads,
To reaſon's eye cleared up a-pace.
Ye vainly wiſe! Ye blind preſumptuous! now,
Confounded in the duſt, adore that Pow'r
And Wiſdom oft arraign'd: ſee now the cauſe,
Why unaſſuming worth in ſecret liv'd
And died neglected; why the good man's ſhare
In life was gall and bitterneſs of ſoul:
Why the lone widow and her orphans pin'd
In ſtarving ſolitude; while luxury,
In palaces, lay ſtraining her low thought,
To form unreal wants: why heav'n-born truth,
And moderation fair, wore the red marks
Of ſuperſtition's ſcourge: why licens'd pain,
That cruel ſpoiler, that emboſom'd foe,
Imbitter'd all our bliſs. Ye good diſtreſt!
Ye noble few! who here unbending ſtand
Beneath life's preſſure, yet bear up a while,
And what your bounded view, which only ſaw
A little part, deem'd evil, is no more:
The ſtorms of wintry time will quickly paſs,
And one unbounded ſpring encircle all.

Thompſon's Winter.

Providence-Plantation, with Rhode-iſland, one of the New-England ſtates, formerly conſtituting a charter government. Its chief town is Newport.

Providence, one of the leaſt of the Bahama iſlands in the American ocean, but the beſt of thoſe planted and fortified by the Engliſh. It is ſeated on the eaſt ſide of the gulph of Florida. W. Long. 77. 35. N. Lat. 25. 0.

PROVINCE, in Roman antiquity, a country of conſiderable extent, which, upon being entirely reduced under the Roman dominion, was new-modelled according to the pleaſure of the conquerors, and ſubjected to the command of annual governors, ſent from Rome; being commonly obliged to pay ſuch taxes and contributions as the ſenate thought fit to demand.

Of theſe countries, that part of France next the Alps was one, and ſtill retains the name *Provence*.

Nicod derives the word *a procul vivendo*, "living afar off;" but it is better deduced from *pro* and *vinco* "I overcome."

Province, in geography, a diviſion of a kingdom or ſtate, compriſing ſeveral cities, towns, &c. all under the ſame government, and uſually diſtinguiſhed by the extent either of the civil or eccleſiaſtical juriſdiction.

The church diſtinguiſhes its provinces by archbiſhoprics; in which ſenſe, England is divided into two provinces, Canterbury and York.

The United Provinces are ſeven provinces of the Netherlands, who, revolting from the Spaniſh dominion, made a perpetual alliance, offenſive and defenſive, at Utrecht, anno 1579. See *United Provinces*.

PROVINCIAL, ſomething relating to a province. It alſo denotes, in Romiſh countries, a perſon who has the direction of the ſeveral convents of a province.

PROVISIONS, in a military ſenſe, implies all manner of eatables, food or provender, uſed in an army, both for man and beaſt.

PROVOST of a city or town, is the chief municipal magiſtrate in ſeveral trading cities, particularly Edinburgh, Paris, &c. being much the ſame with mayor in other places. He preſides in city-courts, and, together with the bailies, who are his deputies, determines in all differences that ariſe among citizens.

The provoſt of Edinburgh is called *lord*, and the ſame title is claimed by the provoſt of Glaſgow. The former calls yearly conventions of the royal boroughs to Edinburgh by his miſſives, and is, *ex officio*, preſident to the convention when met.

PROVOST, *or Prevot-Royal*, a ſort of inferior judge formerly eſtabliſhed throughout France, to take cognizance of all civil, perſonal, real, and mixed cauſes among the people only.

Grand PROVOST *of France*, or *of the Houſehold*, had juriſdiction in the king's houſe, and over the officers therein; looked to the policy thereof, the regulation of proviſions, &c.

Grand PROVOST *of the Conſtable*, a judge who manages proceſſes againſt the ſoldiers in the army who have committed any crime.

He has four lieutenants diſtributed throughout the army, called *provoſts of the army*, and particularly provoſts in the ſeveral regments.

PROVOST *Marſhal of an Army*, is an officer appointed to ſeize and ſecure deſerters, and all other criminals. He is to hinder ſoldiers from pillaging, to indict offenders, and ſee the ſentence paſſed on them executed. He alſo regulates the weights and meaſures, and the price of proviſions, &c. in the army. For the diſcharge of his office, he has a lieutenant, a clerk, and a troop of marſhal-men on horſeback, as alſo an executioner.

There is alſo a provoſt-marſhal in the navy, who hath charge over priſoners, &c.

The French alſo had a provoſt-general of the marines, whoſe duty it was to proſecute the marines when guilty of any crime, and to make report thereof to the council of war; beſides a marine provoſt in every veſſel, who was a kind of gaoler, and took the priſoners into his care, and kept the veſſel clean.

PROVOSTS *of the Marſhals*, were a kind of lieutenants of the marſhals of France; of theſe there were 180 ſeats in France; their chief juriſdiction regarded highwaymen, footpads, houſe-breakers, &c.

PROVOST *of the Mint*, a particular judge inſtituted for the apprehending and proſecuting of falſe coiners.

PROVOST, or *Prevot*, in the king's ſtables; his office is to attend at court, and hold the king's ſtirrup when he mounts his horſe. There are four provoſts of this kind, each of whom attends in his turn, monthly.

PROW, denotes the head or fore-part of a ſhip, particularly in a galley; being that which is oppoſite to the poop or ſtern.

PROXIMITY, denotes the relation of nearneſs, either in reſpect of place, blood, or alliance.

PRUDENCE, in ethics, may be defined an ability of judging what is beſt, in the choice both of ends and means. According to the definition of the Roman moraliſt, *De Officiis*, lib. i. cap. 43. prudence is the knowledge of what is to be deſired or avoided. Accordingly, he makes *prudentia (De Legibus*, lib. i.) to be a contraction of *providentia*, or foreſight. Plato *(De Legibus*, lib. iii.) calls this the leading virtue; and Juvenal, Sat. x. obſerves,

Nullum numen abeſt ſi ſit prudentia.

The idea of prudence includes ευϐȣλια, or due conſultation; that is, concerning ſuch things as demand conſultation in a right manner, and for a competent time, that the reſolution taken up may be neither too precipitate nor too ſlow; and συνησι or a faculty of diſcerning proper means when they occur; and to the perfection of prudence, theſe three things are farther required, viz. δεινοτης, or a natural ſagacity; αγχινοα, preſence of mind, or a ready turn of thought; and εμπειρια, or experience the extremes of prudence are craft or cunning on the one hand which is the purſuit of an ill end by direct and proper though not honeſt means; and folly on the other, which is either a miſtake both as to the end and means, or proſecuting a good end by foreign and improper means. Grove's *Moral Philoſophy*, vol. ii. chap. ii.

PRUDENTIUS, or AURELIUS PRUDENTIUS CLEMENS, a famous Chriſtian poet, under the reign of Theodoſius the Great, who was born in Spain in the year 348. He firſt followed the profeſſion of an advocate, was afterwards a judge, then a ſoldier, and at length had an honourable employment at court. We have a great number of his poems, which, from the choice of his ſubjects, may be termed *Chriſtian Poems*; but the ſtyle is barbarous, and very different from the purity of the Auguſtan age. The moſt eſteemed editions of Prudentius's works are that of Amſterdam, in 1667, with Heinſius's Notes, and that of Paris in 1687, *in uſum Delphini*.

PRUNELLA, in botany: A genus of the gymnoſpermia order, belonging to the didynamia claſs of plants; and in the natural method ranking under the 12th order, *holoraceæ*. The filaments are bifurcated, with an anthera only on one point; the ſtigma is bifid.

PRUNES, are plums dried in the ſunſhine, or in an oven.

PRUNING, in gardening and agriculture, is the lopping off the ſuperfluous branches of trees, in order to make them bear better fruit, grow higher, or appear more regular.

Pruning, though an operation of very general uſe, is nevertheleſs rightly underſtood by few; nor is it to be learned by rote, but requires a ſtrict obſervation of the different manners of growth of the ſeveral ſorts of fruit-trees; the proper method of doing which cannot be known without carefully obſerving how each kind is naturally diſpoſed to produce its fruit: for ſome do this on the ſame year's wood, as vines; others, for the moſt part, upon the former year's wood, as peaches, nectarines, &c.; and others upon ſpurs which are produced upon wood of three, four, &c. to fifteen or twenty years old, as pears, plums, cherries, &c. Therefore, in order to the right management of fruit-trees, proviſion ſhould always be made to have a ſufficient quantity of bearing wood in every part of the trees; and at the ſame time there ſhould not be a ſuperfluity of uſeleſs branches, which would exhauſt the ſtrength of the trees, and cauſe them to decay in a few years.

The reaſons for pruning of fruit-trees, are, 1. To preſerve them longer in a vigorous bearing-ſtate; 2. To render them more beautiful; and, 3. To cauſe the fruit to be larger and better taſted.

The general inſtructions for pruning are as follow. The greateſt care ought to be taken of fruit-trees in the ſpring, when they are in vigorous growth; which is the only proper ſeaſon for procuring a quantity of good wood in the different parts of the tree, and for diſplacing all uſeleſs branches as ſoon as they are produced, in order that the vigour of the tree may be entirely diſtributed to ſuch branches only as are deſigned to remain. For this reaſon trees ought not to be neglected in April and May, when their ſhoots, are produced; however thoſe branches which are intended for bearing the ſucceeding year ſhould not be ſhortened during the time of their growth, becauſe this would cauſe them to produce two lateral ſhoots, from the eyes below the place where they were ſtopped, which would draw much of the ſtrength from the buds of the firſt ſhoot: and if the two lateral ſhoots are not entirely cut away at the winter-pruning, they will prove injurious to the tree. This is to be chiefly underſtood of ſtone-fruit and grapes; but pears and apples, being much harder, ſuffer not ſo much, though it is a great diſadvantage to thoſe alſo to be thus managed. It muſt likewiſe be remarked, that peaches, nectarines, apricots, cherries, and plums, are always in the greateſt vigour when they are leaſt maimed by the knife; for where large branches are taken off, they are ſubject to gum and decay. It is therefore the moſt prudent method to rub off all uſeleſs buds when they are firſt produced, and to pinch others, where new ſhoots are wanted to ſupply the vacancies of the wall; by which management they may be ſo ordered as to want but little of the knife in winter-pruning. The management of pears and apples is much the ſame with theſe trees in ſummer; but in winter they muſt be very differently pruned: for as peaches and nectarines, for the moſt part, produce their fruit upon the former year's wood, and muſt therefore have their branches ſhortened according to their ſtrength, in order to produce new ſhoots for the ſucceeding year; ſo, on the contrary, pears, apples, plums, and cherries, producing their fruit upon ſpurs, which come out of the wood of five, ſix, and ſeven years old, ſhould not be ſhortened, becauſe thereby thoſe buds which were naturally diſpoſed to form theſe ſpurs, would produce wood-branches; by which means the trees would be filled with wood, but would never produce much fruit. The branches of ſtandard-trees ſhould never be ſhortened unleſs where they are very luxuriant, and, by growing irregularly on one ſide of the trees, attract the greateſt part of the ſap, by which means the other parts are either unfurniſhed with branches, or are rendered very weak; in which caſe the branch ſhould be ſhortened down as low as is neceſſary, in order to obtain more branches to fill up the hollow of the tree: but this is only to be underſtood of pears and apples, which will produce ſhoots from wood of three, four, or more years old; whereas moſt ſorts of ſtone-fruit will gum and decay after ſuch amputations: whenever this happens to ſtone-fruit, it ſhould be remedied by ſtopping or pinching thoſe ſhoots in the ſpring, before they have obtained too much vigour, which will cauſe them to puſh out ſide-branches; but this muſt be done with caution. You muſt alſo cut out all dead or decaying branches, which cauſe their heads to look ragged, and alſo attract noxious particles from the air: in doing of this, you ſhould cut them cloſe down to the place where they were produced, otherwiſe that part of the branch which is left will alſo decay, and prove equally hurtful to the reſt of the tree; for it ſeldom happens, when a branch begins to decay, that it does not die quite down to the place where it was produced, and if permitted to remain long uncut, often infects ſome of the other parts of the tree. If the branches cut off are large, it will be very proper, after having ſmoothed the cut part exactly even with a knife, chiſſel, or hatchet, to put on a plaſter of grafting clay, which will prevent the wet from ſoaking into the tree at the wounded part. All ſuch branches as run acroſs each other, and occaſion a confuſion in the head of the tree, ſhould be cut off; and as there are frequently young vigorous ſhoots on old trees, which riſe from the old branches near the trunk, and grow upright into the head, theſe ſhould be carefully cut out every year, leſt, by being permitted to grow, they fill the tree too full of wood.

As to the pruning of foreſt-trees, if they be large, it is beſt not to prune them at all; yet, if there be an abſolute neceſſity, avoid taking off large boughs as much as poſſible. And, 1, If the bough be ſmall, cut it ſmooth, cloſe, and ſloping. 2. If the branch be large, and the tree old, cut it off at three or four feet from the ſtem. 3. If the tree grow crooked, cut it off at the crook, ſloping upward, and nurſe up one of the moſt promiſing ſhoots for a new ſtem. 4. If the tree grow top-heavy, its head muſt be lightened, and that by thinning the boughs that grow out of the main branches. But if you would have them ſpring, rub off the buds, and ſhroud up the ſide-ſhoots. 5. If the ſide-bough ſtill break out, and the top be able to ſuſtain itſelf, give the boughs that put forth in ſpring a pruning after Midſummer, cutting them cloſe.

PRUNUS, in botany: A genus of the monogynia order, belonging to the icoſandria claſs of plants; and in the natural method ranking under the 36th order, *Pomaceæ*. The calyx is quinquefid, inferior; there are five petals; the fruit is a plum, having a kernel with prominent ſutures. There are 15 ſpecies, of which ſix are cultivated in Britain: they are originally natives of America and Siberia.

1. The domeſtica, or common plum-tree, grows 20 or 30 feet high, garniſhed with oval, ſpear-ſhaped leaves, and with the pedunculi for the moſt part ſingle, terminated by flowers, ſucceeded by plums of many different colours, ſizes, and ſhapes in the varieties. 2. The inſititia, wild-plum, or bullace-tree, grows 12 or 15 feet high; the branches ſomewhat ſpinous; the leaves oval, hairy underneath; and the pedunculi by pairs, terminated by white flowers ſucceeded by ſmall, round, plum-like fruit of different colours in the varieties. 3. The ſpinoſa, black-thorn, or ſloe-tree, grows 10 or 12 feet high, very branchy and buſhy quite from bottom, armed with ſtrong, ſharp ſpines, ſmall, ſpear-ſhaped, ſmooth leaves, pedunculi growing ſingly, terminated by flowers, ſucceeded by ſmall, round, black cherries in autumn. It grows wild everywhere in hedges and woods; and is very proper for planting field hedges, being of very quick and cloſe growth. 4. The ceraſus, or common cherry-tree, grows 20 feet or more in height, garniſhed with oval cluſters of lanceolate, ſmooth leaves, umbellate flowers, ſucceeded by cluſters of red roundiſh fruit of different ſizes and properties in the varieties. Hanbury ſays, "were this tree ſcarce, and with much difficulty propagated, every man, though poſſeſſed of a ſingle tree only, would look upon it as a treaſure; for beſides the charming appearance theſe trees have, when beſnowed, as it were, all over with bloom in the ſpring, can any tree in the vegetable tribe be conceived more beautiful, ſtriking, and grand, than a well-grown and healthy cherry-tree, at that period when the fruit is ripe."

The many kinds of cherry-trees afford an almoſt endleſs variety; all differing in ſome reſpect in their manner of ſhooting, leaves, flowers, or fruit: two in particular demand admiſſion into the pleaſure-garden; the double-bloſſomed and the red-flowering. The pleaſing ſhow the common cherry-tree makes when in blow is known to all; but that of the double bloſſomed is much more enchanting. It bloſſoms like the other in May; the flowers are produced in large and noble cluſters; for each ſeparate flower is as double as a roſe, is very large, and placed on long and ſlender footſtalks, ſo as to occaſion the branches to have an air of eaſe and freedom. They are of a pure white; and the trees will be ſo profuſely covered with them, as to charm the imagination. Standards of theſe trees, when viewed at a diſtance, have been compared to balls of ſnow; and the nearer we approach, the greater pleaſure we receive. Theſe trees may be kept as dwarfs, or trained up to ſtandards; ſo that there is no garden or plantation to which they will not be ſuitable. By the multiplicity of the petals the organs of generation are deſtroyed; ſo that thoſe flowers which are really full are never ſucceeded by any fruit.

The red-flowering cherry-tree differs in no reſpect from the common cherry-tree, only that the flowers are of a pale-red colour, and by many are eſteemed on that account. Beſides the ornament and utility afforded us by the flowers and fruit of the cherry, its timber is a further inducement for propagating it; more eſpecially that of the ſmall black wilding ſort; which may perhaps with propriety be conſidered as the genuine ſpecies, and a native of Britain. Be this as it may, it will grow, in a ſoil and ſituation it affects, to be a large timber tree; which, if taken in its prime before it become tainted at the heart, will turn out perhaps not leſs than a ton of valuable materials, peculiarly adapted to the purpoſes of furniture. The grain is fine, and the colour nearly approaching to that of mahogany, to which valuable wood it comes nearer than any other which this country produces. 5. The avium, or great wild-cherry tree, grows 40 or 50 feet high, having oval, ſpear-ſhaped leaves, downy underneath, with umbellate ſeſſile cluſters of white flowers, ſucceeded by ſmall round fruit of different properties in the varieties. 6. The padus, or common bird-cherry tree, grows 15 or 20 feet high, of a ſhrub-like growth, with a ſpreading head, large, oblong, rough, ſerrated leaves, having two glands at the back of the baſe like the other, and with ſhorter, more compact cluſters of flowers, ſucceeded by large red fruit. This grows wild in hedges in the north parts of England. 7. The Virginiana, or Virginian bird-cherry, grows 30 feet high, dividing into a very branchy head, having a dark purple bark, oval, ſlightly ſerrated, ſhining green leaves, having two glands at the forepart of the baſe, and long cluſters of white flowers, ſucceeded by ſmall, round, berry-like, black fruit. 8. The Canadenſis, or Canada dwarf bird cherry, grows but four or five feet high, branching horizontally near the ground with ſmooth branches; broad, ſpear-ſhaped, rough downy leaves, without glands; and long cluſters of white flowers, ſucceeded by ſmall, round, berry-like, black fruit, ripe in autumn. 9. The mahaleb, or perfumed cherry, grows 10 or 15 feet high, with ſmooth whitiſh branches, ſmall, oval, ſhining green leaves, and corymbous cluſters of white flowers, ſucceeded by ſmall fruit. 10. The armeniaca, or apricot tree, grows 20 feet high, with a large ſpreading head, having reddiſh ſhoots, large nearly heart-ſhaped leaves, and cloſe-ſitting pale-red flowers riſing all along the ſides of the young branches; ſucceeded by large, roundiſh fruit of a yellow and reddiſh colour in different varieties. The fruit and the kernels of the *Prunus Siberica*, when eaten, excite a continued head-ach: the kernels, infuſed in brandy, communicate an agreeable flavour.

Culture. All the different varieties of plums have at firſt been raiſed from the ſtones, and are afterwards preſerved by budding and grafting on any plum-ſtock. The ſame method is applicable to cherries; only theſe are grafted to moſt advantage upon ſtocks of the wild black and red cherry raiſed from the ſtones of the fruit. The apricot-trees are propagated by budding on any kind of plum-ſtocks.

PRUSA (anc. geog.), a town ſituated at mount Olympus in Myſia, built by Pruſias, who waged war with Crœſus, (Strabo); with Cyrus, (Stephanus); both cotemporary princes. Now called *Burſa* or *Pruſa*, capital of Bithynia, in Aſia Minor. E. Long. 29. 5. N. Lat. 39. 22.

PRUSIAS, the name of ſeveral kings of Bithynia.

PRUSIAS, a town of Bithynia, anciently called *Cius*, from a cognominal river, and giving name to the Sinus Cianus of the Propontis; rebuilt by Pruſias the ſon of Zela, after having been deſtroyed by Philip the ſon of Demetrius: it ſtood on the Sinus Cianus, at the foot of mount Arganthonius. This is the Pruſias who harboured Annibal after the defeat of Antiochus.—Of this place was Aſclepiades, ſurnamed *Pruſieus*, the famous phyſician.

Plate CCCCX.

PRUSSIA, a modern, but deſervedly celebrated kingdom of Europe, whoſe monarch, along with Pruſſia Proper, poſſeſſes alſo the electorate of Brandenburg, and ſome other territories of conſiderable extent. The diſtrict properly called *Pruſſia* is of great extent, and divided into the Ducal and Regal Pruſſia, the latter belonging to the republic of Poland till the late partition of the Poliſh territories. Both together are of great extent; being bounded on the north by the Baltic, on the ſouth by Poland and the duchy of Mazovia, on the weſt by Pomerania, and on the eaſt by Lithuania and Samogitia.

1 Etymology of the name.

The name is by ſome thought to be derived from the *Boruſſi*, a tribe of the Sarmatians, who, migrating from the foot of the Riphæan mountains, were tempted by the beauty and fertility of the country to ſettle there. Others think that the name of this country is properly *Poruſſia; Po* in the language of the natives ſignifying *near*, and *Poruſſia* ſignifying *near Ruſſia*. To the latter etymology we find the king of Pruſſia himſelf aſſenting in the treatiſe intitled *Memoirs of the Houſe of Brandenburg*. However, it muſt be owned, that theſe or any other etymologies of the word are very uncertain, and we find nothing like it mentioned by hiſtorians before the tenth century.

2 Extreme barbarity of the ancient inhabitants.

The ancient ſtate of Pruſſia is almoſt entirely unknown. However, the people are ſaid to have been very ſavage and barbarous; living upon raw fleſh, and drinking the blood of horſes at their feaſts, according to Stella, even to intoxication (A). Nay, ſo extremely ſavage

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(A) This author does not mention any particular method by which they communicated an inebriating quality to the blood of animals. Poſſibly, however, the vital fluid may have a property of this kind, though unknown in our days where ſuch barbarous cuſtoms are diſuſed. Drunkenneſs from drinking blood is frequently mentioned in Scripture, but whether literally or metaphorically muſt be decided by the learned.

ſavage were this people, that they were even unacquainted with the method of conſtructing huts, and took up their dwelling in caves and cavities of rocks and trees, where they protected themſelves and children from the inclemencies of the weather. Among ſuch a people it is vain to expect that any tranſactions would be recorded, or indeed that any thing worthy of being recorded would be tranſacted. We ſhall therefore begin our hiſtory of Pruſſia with the time when the Teutonic knights firſt got footing in the country. (See *Teutonic Knights*).

3 Teutonic knights firſt get footing in the country.

On the expulſion of the Chriſtians from the Holy Land by Saladin, a ſettlement was given to the Teutonic knights in Pruſſia by Conrade duke of Mazovia, the competitor of Boleſlaus V. for the crown of Poland. Their firſt reſidence in this country was Culm; to which territory they were confined by the conditions of the donation, excepting what they could conquer from their pagan neighbours, all which the emperor granted to them in perpetuity.

Encouraged by this grant, the knights conquered the greateſt part of the country which now goes by the name of *Pruſſia;* and, not content with this, became very troubleſome to Poland, inſomuch that the monarchs of that kingdom were ſometimes obliged to carry on dangerous and bloody wars with them; for an account of which we refer to the article Poland, n° 61. 67, &c.

The Teutonic order continued in Pruſſia till the year 1531. Their laſt grand-maſter was Albert Marquis of Brandenburg, and nephew to Sigiſmund I. king of Poland. He was preferred to this dignity in hopes that his affinity to Sigiſmund might procure a reſtitution of ſome of the places which had been taken from the order during the former unſucceſsful wars with Poland; but in this the fraternity were diſappointed. Albert, however, was ſo far from endeavouring to obtain any favour from his uncle by fair means, that he refuſed to do homage to him, and immediately began to make preparations for throwing off his dependence altogether, and recovering the whole of Pruſſia and Pomerania by force of arms. In this he was ſo far from ſucceeding, that, being foiled in every attempt, he was forced to reſign the dignity of grand-maſter; in recompence for which, his uncle beſtowed on him that part of Pruſſia now called *Ducal*, in quality of a ſecular duke. It was now the intereſt of the houſe of Brandenburg to aſſiſt in the expulſion of the fraternity; and accordingly, being at laſt driven out of Pruſſia and Pomerania, they transferred their chapter to Mariendal in Franconia; but in that and other provinces of the empire where they ſettled, little more than the name of the order once ſo famous now remains.

4 Expelled.

5 Hiſtory of Brandenburg.

The other moſt conſiderable part of his Pruſſian majeſty's dominions is the electorate of Brandenburg. Like other parts of Germany, it was anciently poſſeſſed by barbarians, of whom no hiſtory can be given. Theſe were ſubdued by Charlemagne, as is related under the article France*; but being on every occaſion ready to revolt, in 927 Henry the Fowler eſtabliſhed margraves, or governors of the frontiers, to keep the barbarians in awe. The firſt margrave of Brandenburg was Sigefroy, brother-in-law to the abovementioned emperor; under whoſe adminiſtration the biſhoprics of Brandenburg and Havelberg were eſtabliſhed by Otho I. From this Sigefroy, to the ſucceſſion of the houſe of Hohenzollern, from whom the preſent elector is deſcended, there are reckoned eight different families, who have been margraves of Brandenburg; namely, the family of the Saxons, of Walbeck, Staden, Plenck, Anhalt, Bavaria, Luxemburg, and Miſnia. The margraves of the four firſt races had continual wars with the Vandals and other barbarous people; nor could their ravages be ſtopped till the reign of Albert ſurnamed *the Bear*, the firſt prince of the houſe of Anhalt. He was made margrave by the emperor Conrad III. and afterwards raiſed to the dignity of elector by Frederic Barbaroſſa, about the year 1100. Some years afterwards the king of the Vandals dying without iſſue, left the Middle Marche by his laſt will to the elector, who was beſides poſſeſſed of the old March, Upper Saxony, the country of Anhalt, and part of Luſace. In 1332 this line became extinct, and the electorate devolved to the empire. It was then given by the emperor Louis of Bavaria to his ſon Louis, who was the firſt of the ſixth race. Louis the Roman ſucceeded his brother; and as he alſo died without children, he was ſucceeded by Otho, his third brother, who ſold the electorate to the emperor Charles IV. of the houſe of Luxemburg, for 200,000 florins of gold. Charles IV. gave the Marche to his ſon Winceſlaus, to whom Sigiſmund ſucceeded. This elector, being embarraſſed in his circumſtances, ſold the New Marche to the knights of the Teutonic order. Joſſe ſucceeded Sigiſmund; but aſpiring to the empire, ſold the electorate to William duke of Miſnia; who, after he had poſſeſſed it for one year, ſold it again to the emperor Sigiſmund. In 1417, Frederic VI. burgrave of Nuremberg, received the inveſtiture of the country of Brandenburg at the diet of Conſtance from the hands of the emperor Sigiſmund; who, two years before, had conferred upon him the dignity of elector, and arch-chamberlain of the Holy Roman empire.

This prince, the firſt of the family of Hohenzollern, found himſelf poſſeſſed of the Old and Middle Marche, but the dukes of Pomerania had uſurped the Marche Ukraine. Againſt them, therefore, the elector immediately declared war, and ſoon recovered the province. As the New Marche ſtill continued in the hands of the Teutonic knights, to whom it had been ſold as we have already mentioned, the elector, to make up for this, took poſſeſſion of Saxony, which at that time happened to be vacant by the death of Albert the laſt elector of the Anhalt line. But the emperor, not approving of this ſtep, gave the inveſtiture of Saxony to the duke of Miſnia; upon which Frederic voluntarily deſiſted from his acquiſitions. This elector made a diviſion of his poſſeſſions by will. His eldeſt ſon was deprived of his right on account of his having too cloſely applied himſelf to ſearch for the philoſopher's ſtone; ſo he left him only Voigtland. The electorate was given to his ſecond ſon Frederic; Albert, ſurnamed *Achilles*, had the duchies of Franconia; and Frederic, ſurnamed the *Fat*, had the Old Marche; but by his death it returned to the electorate of Brandenburg.

Frederic I. was ſucceeded by his ſon, called alſo *Frederic*, and ſurnamed *Iron-tooth* on account of his ſtrength. He might with as great reaſon have been ſurnamed *the Magnanimous*, ſince he refuſed two crowns viz. that of Bohemia, which was offered him

* N° 27, &c.

by the pope, and the kingdom of Poland to which he was invited by the people; but Frederic declared he would not accept of it unleſs Caſimir brother to Ladiſlaus the late king refuſed it. Theſe inſtances of magnanimity had ſuch an effect on the neighbouring people, that the ſtates of Lower Luſatia made a voluntary ſurrender of their country to him. But as Luſatia was a fief of Bohemia, the king of that country immediately made war on the elector, in order to recover it. However, he was ſo far from being ſucceſsful, that, by a treaty of peace concluded in 1462, he was obliged to yield the perpetual ſovereignty of Corbus, Peits, Sommerfield, and ſome other places to the elector. Frederic then, having redeemed the New Marche from the Teutonic order for the ſum of 100,000 florins, and ſtill further enlarged his dominions, reſigned the ſovereignty in 1469 to his brother Albert, ſurnamed *Achilles*.

6 Exploits of Albert ſurnamed Achilles.

Albert was 57 years old when his brother reſigned the electorate to him. Moſt of his exploits, for which he had the ſurname of *Achilles*, had been performed while he was burgrave of Nuremberg. He declared war againſt Lewis duke of Bavaria, defeated, and took him priſoner. He gained eight battles againſt the Nurembergers, who had rebelled and conteſted his rights to the burgraviate. In one of theſe he fought ſingly againſt 16 men, till his people came up to his aſſiſtance. He made himſelf maſter of the town of Grieſſenburg in the ſame manner that Alexander the Great took the capital of the Oxydracæ, by leaping from the top of the walls into the town, where he defended himſelf ſingly againſt the inhabitants till his men forced the gates and reſcued him. The confidence which the emperor Frederic III. placed in him, gained him the direction of almoſt the whole empire. He commanded the Imperial armies againſt Lewis the Rich duke of Bavaria; and againſt Charles the Bold duke of Burgundy, who had laid ſiege to Nuis, but concluded a peace at the interpoſition of Albert. He gained the prize at 17 tournaments, and was never diſmounted.

7 Pruſſia and Brandenburg united.

All theſe exploits, however, had been performed before Albert obtained the electorate. From that time we meet with no very important tranſactions till the year 1594, when John Sigiſmund of Brandenburg, having married Anne the only daughter of Albert duke of Pruſſia, this united that duchy to the electorate, to which it has continued to be united ever ſince; and obtained pretenſions to the countries of Juliers, Berg, Cleves, Marck, Ravenſburg, and Ravenſtein, to the ſucceſſion of which Anne was heireſs.

8 Unfortunate reign of the elector George William.

Sigiſmund died in 1619, and was ſucceeded by his ſon George William; during whoſe government the electorate ſuffered the moſt miſerable calamities. At this time it was that the war commenced between the Proteſtants and Catholics, which laſted 30 years. The former, although leagued together, were on the point of being utterly deſtroyed by the Imperialiſts under the command of Count Tilly and Wallenſtein, when Guſtavus Adolphus of Sweden turned the ſcale in their favour, and threatened the Catholic party with utter deſtruction*. But by his death at the battle of Lutzen, the fortune of war was once more changed. At laſt, however, peace was concluded with the emperor; and, in 1640, the elector died, leaving his dominions to his ſon Frederic William, ſurnamed the *Great*.

9 Reign of Frederic William the Great.

This young prince, though only 20 years of age at the time of his acceſſion, applied himſelf with the utmoſt diligence to repair the loſſes and devaſtations occaſioned by the dreadful wars which had preceded. He received the inveſtiture of Pruſſia perſonally from the king of Poland, on condition of paying 100,000 florins annually, and not making truce or peace with the enemies of that crown. His envoy likewiſe received the inveſtiture of the electorate from the emperor Ferdinand III. The elector then thought of recovering his provinces from thoſe who had uſurped them. He concluded a truce for 20 years with the Swedes, who evacuated the greateſt part of his eſtates. He likewiſe paid 140,000 crowns to the Swediſh garriſons, which ſtill poſſeſſed ſome of his towns; and he concluded a treaty with the Heſſians, who delivered up a part of the duchy of Cleves; and obtained of the Hollanders the evacuation of ſome other cities.

10 Treaty of Weſtphalia concluded.

In the mean time, the powers of Europe began to be weary of a war which had continued for ſuch a length of time with ſuch unrelenting fury. The cities of Oſnaburg and Munſter being choſen as the moſt proper places for negociation, the conferences were opened in the year 1645; but, by reaſon of the multiplicity of buſineſs, they were not concluded till two years after. France, which had eſpouſed the intereſts of Sweden, demanded that Pomerania ſhould be ceded to that kingdom as an indemnification for the expences which the war had coſt Guſtavus Adolphus and his ſucceſſors. Although the empire and the elector refuſed to give up Pomerania, it was at laſt agreed to give up to the Swedes Hither Pomerania, with the iſles of Rugen and Wollin, alſo ſome cities; in return for which ceſſion, the biſhoprics of Halberſtadt, Minden, and Camin, were ſecularized in favour of the elector, of which he was put in poſſeſſion, together with the lordſhips of Hochenſtein and Richenſtein, with the reverſion of the archbiſhopric of Magdeburg. This was the treaty of Weſtphalia concluded in 1648, and which ſerves as a baſis to all the poſſeſſions and rights of the German princes. The elector then concluded a new treaty with the Swedes, for the regulation of limits, and for the acquittal of ſome debts, of which Sweden would only pay a fourth; and next year the electorate, Pomerania, and the duchies of Cleves, were evacuated by the Swedes.

11 The elector ſucceeds againſt the Swedes.

Notwithſtanding all theſe treaties, however, the Swedes ſoon after invaded Pomerania, but were entirely defeated by the elector near the town of Fehrbellin. Three thouſand were left dead on the ſpot, among whom were a great number of officers; and a great many were taken priſoners. The elector then purſued his victory, gained many advantages over the Swedes, and deprived them of the cities of Stralſund and Gripſwald. On this the Swedes, hoping to oblige the elector to evacuate Pomerania, which he had almoſt totally ſubdued, invaded Pruſſia, from Livonia, with 16,000 men; and advancing into the country, they burned the ſuburbs of Memel, and took the cities of Tilſe and Inſterburg. The elector, to oppoſe the invaders, left Berlin on the 10th of January 1679, at the head of 9000 men. The Swedes retired at his approach, and were greatly haraſſed by the troops on their march. So ſucceſsful indeed was the elector on this occaſion, that the Swedes loſt almoſt one half of their army killed or taken priſoners. At laſt, having croſſed the bay of Friſch-haff and Courland on the ice, he arrived on the 19th of January, with his infantry, within three miles of Tilſe, where the Swedes had their head-quarters. The ſame day, his general, Trefenfeldt, defeated two regiments of the enemy near Splitter; and the Swedes who were in Tilſe abandoned that place, and retired towards Courland. They were purſued by General Gortz, and entirely defeated with ſuch ſlaughter, that ſcarce 3000 of them returned to Livonia. Yet, notwithſtanding all theſe victories, the elector being preſſed on the other ſide by the victorious generals of France, M. Turenne and the prince of Conde, was obliged to make peace with the Swedes. The conditions were, that the treaty of Weſtphalia ſhould ſerve for a baſis to the peace; that the elector ſhould, have the property of the cuſtoms in all the ports of Further Pomerania, with the cities of Camin, Gartz, Grieffenburg, and Wildenbruck: on his part, he conſented to give up to the Swedes all that he had conquered from them, and to give no aſſiſtance to the king of Denmark, upon condition that France delivered up to him his provinces in Weſtphalia, and paid him 300,000 ducats, as an indemnification for the damages done by the French to his ſtates. This treaty was ſtyled *the peace of St Germain*.

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* See Sweden.

12
Is obliged to conclude a treaty of peace with them.

13
A ſtrange embaſſy from the cham of Tartary.

With the treaty of St Germain terminated the military exploits of Frederic William, who paſſed the laſt years of his adminiſtration in peace. His great qualities had rendered him reſpected by all Europe, and had even been heard of in Tartary. He received an embaſſy from Murad Geray, cham of the Tartars, courting his friendſhip. The barbarian ambaſſador appeared in ſuch tattered clothes as ſcarce covered his nakedneſs, ſo that they were obliged to furniſh him with other clothes before he could appear at court. His interpreter had a wooden noſe and no ears. In 1684, Frederic received into his dominions great numbers of Proteſtants who fled out of France from the perſecutions of Louis XIV. after he had revoked the edict of Nantz. Twenty thouſand of them are ſaid to have ſettled at this time in the electorate, where they introduced new arts and manufactures, that were of the utmoſt benefit to the country. By this, however, he diſobliged Louis XIV. for which reaſon he concluded an alliance with the emperor; and having furniſhed him with 8000 troops againſt the Turks in Hungary, the emperor yielded to him the circle of Schwibus in Sileſia, as an equivalent for all his rights in that province.

14
Frederic III. obtains the title of king of Pruſſia.

In 1688, the elector Frederic William died, and was ſucceeded by his ſon Frederic III. This prince was remarkably fond of ſhow and ceremony, which, during the courſe of his government, involved him in much expence. The regal dignity ſeemed to be the greateſt object of his ambition. To obtain this, he joined with the emperor in the alliance againſt France, in which he was engaged by William III. king of Britain. He alſo yielded up the circle of Schwibus, which had been given to his predeceſſor; and, in 1700, obtained from the emperor that dignity which he had ſo earneſtly deſired. The terms on which it was obtained were, 1. That Frederick ſhould never ſeparate from the empire thoſe provinces of his dominions which depended on it. 2. That he ſhould not, in the emperor's preſence, demand any other marks of honour than thoſe which he had hitherto enjoyed. 3. That his Imperial majeſty, when he wrote to him, ſhould only give him the title of *Royal Dilection*. 4. That nevertheleſs the miniſters which he had at Vienna ſhould be treated like thoſe of other crowned heads. 5. That the elector ſhould maintain 6000 men in Italy at his own expence, in caſe the emperor ſhould be obliged to make war on account of the ſucceſſion of the houſe of Bourbon to the crown of Spain. 6. That thoſe troops ſhould continue there as long as the war laſted.

Thus was the kingdom of Pruſſia eſtabliſhed through the friendſhip of the emperor, with whom Frederic I. ſo called as being the firſt king of Pruſſia, continued all his life in ſtrict alliance. Indeed he was a pacific prince and though contemptible in his perſon, and incapable of atchieving great things, had this merit, that he always preſerved his dominions in peace, and thus conſulted the true intereſt of his ſubjects much more than thoſe monarchs who have dazzled the eyes of the world by their military exploits. He was indeed vain, and fond of ſhow, as we have already obſerved; but had a good heart, and is ſaid never to have violated his conjugal vow; though it does not appear that he was greatly beloved by his royal conſorts (of whom he had three) on that or any other account.

15
Frederic II. of Pruſſia a martial prince.

Frederic I. died in the beginning of 1713, and was ſucceeded by Frederic William. He was in almoſt every thing the reverſe of his father. His diſpoſitions were altogether martial; ſo that he applied himſelf entirely to the augmentation of his army, and perfecting them in their exerciſe, by which means they became the moſt expert ſoldiers in Europe. His foible was an ambition of having his army compoſed of men above the ordinary ſize; but as theſe could not be procured, he compoſed a regiment of the talleſt men he could find; and as his officers made no ſcruple of picking up ſuch men wherever they could find them for his majeſty's uſe, the neghbouring ſtates were frequently offended, and a war was often likely to enſue even from this ridiculous cauſe. However, his Pruſſian majeſty was never engaged in any martial enterpriſe of conſequence: but having put his army on the moſt reſpectable footing of any in the world, and filled his coffers, for he was of a very ſaving diſpoſition, he put it in the power of his ſon to perform thoſe exploits which have been matter of aſtoniſhment to all Europe.

16
Enmity between Pruſſia and Auſtria.

It was in this king's reign that Pruſſia firſt perceived her natural enemy and rival to be the houſe of Auſtria, and not France as had been formerly ſuppoſed. Hence frequent bickerings took place between theſe two powers, for which the perſecution of the Proteſtants by ſome of the catholic ſtates of the empire afforded a pretence; and though a war never actually took place, yet it was eaſy to ſee that both were mortal enemies to each other. But when Frederic William died in 1740, this enmity broke out in full force. The empreſs queen was then left in a very diſagreeable ſituation, as has been obſerved under the article Britain, n° 410, &c. Of this Frederic II. took the advantage to do himſelf juſtice, as he ſaid, with regard

17
Frederic II. ſeizes Sileſia.

to Sileſia, of which his anceſtors had been unjuſtly deprived. This province he ſeized at that time: but it coſt him dear; for the empreſs, having at laſt overcome all difficulties, formed againſt him the moſt terrible combination that ever was known in Europe.

18
Combination againſt him.

The treaty was hardly concluded with the king of Pruſſia, by which ſhe reluctantly yielded up the province of Sileſia, and with it a clear revenue of L. 800,000 a-year, before ſhe entered into another with the court of Peterſburg, which was concluded May 22. 1746. This treaty, as far as it was made public, was only of a defenſive nature; but ſix ſecret and ſeparate articles were added to it. By one of theſe it was provided, that in caſe his Pruſſian majeſty ſhould attack the empreſs-queen, or the empreſs of Ruſſia, or even the republic of Poland, it ſhould be conſidered as a breach of the treaty of Dreſden, by which Sileſia was given up. It was alſo ſtipulated, that, notwithſtanding that treaty (which indeed had been dictated by the king of Pruſſia himſelf), the right of the empreſs-queen to Sileſia ſtill continued, and for the recovery of that province the contracting powers ſhould mutually furniſh an army of 60,000 men. To this treaty, called the treaty of *Peterſburg*, the king of Poland was invited to accede; but he, being in a manner in the power of the king of Pruſſia, did not think proper to ſign it: however, he verbally acceded to it in ſuch a manner, that the other parties were fully convinced of his deſign to cooperate with all their meaſures; and in conſideration of this intention, it was agreed that he ſhould have a ſhare in the partition of the king of Pruſſia's dominions, in caſe of a ſucceſsful event of their enterpriſes.

19
He invades Saxony.

20
And takes 16,000 Saxons priſoners.

In conſequence of theſe machinations, every art was uſed to render the king of Pruſſia perſonally odious to the empreſs of Ruſſia; the queen of Hungary made vaſt preparations in Bohemia and Moravia; and the king of Poland, under pretence of a military amuſement, drew together 16,000 men, with whom he occupied a ſtrong poſt at Pirna. The queen of Hungary, ſtill further to ſtrengthen herſelf, concluded a treaty with the court of France at Verſailles, dated May 1. 1756. But in the mean time, the king of Pruſſia having underſtood by his emiſſaries what was going forward, reſolved to be beforehand with his enemies, and at leaſt to keep the war out of his own country; and therefore entered Saxony with a conſiderable army. At firſt he affected only to demand a free paſſage for his troops, and an obſervance of the neutrality profeſſed by the king of Poland; but, having good reaſons to doubt this neutrality, he demanded, as a preliminary, that theſe Saxon troops ſhould immediately quit the ſtrong poſt they occupied, and diſperſe themſelves. This demand was refuſed; on which his Pruſſian majeſty blockaded the Saxon camp at Pirna, reſolving to reduce it by famine, ſince its ſtrong ſituation rendered an attack very dangerous. At that time there were in Bohemia two Saxon armies, one under the command of M. Brown, and the other under M. Picolomini. To keep theſe in awe, the king had ſent M. Schwerin with an army into Bohemia from the country of Glatz, and M. Keith had penetrated into the ſame kingdom on the ſide of Miſnia. But ſtill the king of Pruſſia did not entirely confide in theſe diſpoſitions; and therefore fearing leaſt M. Brown might afford ſome aſſiſtance to the Saxons, he joined his forces under Keith, and on December 1. attacked and defeated the Auſtrian general, ſo that the latter found it impoſſible to relieve the Saxons, who, after a vain attempt to retire from their poſt, were all taken priſoners. The king of Poland quitted his dominions in Germany, and the Pruſſians took up their winter-quarters in Saxony. Here they ſeized on the revenues, levied exorbitant contributions, and obliged the country to furniſh them with recruits. The king of Pruſſia at this time made himſelf maſter of the archives of Dreſden, by which means he procured the originals of thoſe pieces abovementioned, which, when produced to the world, gave a full proof of the combination that had been formed againſt him, and conſequently juſtified the meaſures he had taken for his own defence.

21
He is proſecuted in the Aulic council, and put to the ban of the empire.

22
Prodigious preparations againſt him.

No ſooner had the king entered Saxony, in the manner already related, than a proceſs was commenced againſt him in the emperor's Aulic council, and before the diet of the empire, where he was ſoon condemned for contumacy, and put to the ban of the empire.—The various circles of the empire were ordered to furniſh their contingents of men and money to put this ſentence in execution; but theſe came in ſo ſlowly, that, had it not been for the aſſiſtance of the French under the prince de Soubiſe, the army would probably have never been in a condition to act. The Auſtrians, in the mean time, made great preparations, and raiſed 100,000 men in Bohemia, whom they committed to the care of prince Charles of Lorrain, aſſiſted by M. Brown. The Czarina ſent a body of 60,000 men under M. Apraxin, to invade the Ducal Pruſſia; whilſt a ſtrong fleet was equipped in the Baltic, in order to co-operare with that army. The king of Sweden alſo acceded to the confederacy, in hopes of recovering the poſſeſſions in Pomerania which his anceſtors had enjoyed; and the duke of Mecklenburg took the ſame party, promiſing to join the Swediſh army with 6000 men as ſoon as it ſhould be neceſſary. On the king of Pruſſia's ſide appeared nobody excepting an army of between 30,000 and 40,000 Hanoverians commanded by the duke of Cumberland; and theſe were outnumbered and forced to yield to a ſuperior army of French commanded by M. D'Etrees.

23
He invades Bohemia, and totally defeats the Auſtrian army.

In the mean time, his Pruſſian majeſty, finding that he muſt depend for aſſiſtance ſolely on his own abilities, reſolved to make the beſt uſe of his time. Accordingly, in the ſpring 1757, his armies poured into Bohemia from two different quarters, while the king himſelf prepared to enter it from a third. M. Schwerin entered from Sileſia; the prince of Bevern from Luſatia, where he defeated an army of 28,000 Auſtrians that oppoſed his paſſage. As the intentions of the king himſelf were not known, the Auſtrians detached a body of 20,000 men from their main army to obſerve his motions. This was no ſooner done than the king cut off all communication between the detachment and the main body; and having joined his two generals with incredible celerity, he engaged the Auſtrians near Prague, totally defeated them, took their camp, military cheſt, and cannon; but loſt the brave general Schwerin, who was killed at the age of 82, with a colonel's ſtandard in his hand. On the Auſtrian ſide, M. Brown was wounded, and died in a ſhort time, though it is ſuppoſed more from the chagrin he ſuffered, than from the dangerous nature of the wound itſelf.

24 Beſieges and bombards Prague.

About 40,000 of the Auſtrian army took refuge in Prague, while the reſt fled different ways. The city was inſtantly inveſted by the king, and all ſuccours were cut off. The great number of troops which it contained rendered an attack unadviſable, but ſeemed to render the reduction of it by famine inevitable; however, the king, to accompliſh his purpoſe the more ſpeedily, prepared to bombard the town. On the 29th of May, after a moſt dreadful ſtorm of thunder and lightning, four batteries began to play on the city. From theſe were thrown, every 24 hours, 288 bombs, beſides a vaſt number of red-hot balls, ſo that it was ſoon on fire in every quarter. The garriſon made a vigorous defence, and one well-conducted ſally; but had the misfortune to be repulſed with great loſs. The magiſtrates, burghers, and clergy, ſeeing their city on the point of being reduced to an heap of rubbiſh, ſupplicated the commander in the moſt earneſt manner to capitulate; but he was deaf to their intreaties, and drove 12,000 of the moſt uſeleſs mouths out of town, who were quickly driven in again by the Pruſſians.

25 Count Daun takes the command of the Auſtrian army.

Thus the affairs of the empreſs-queen ſeemed verging to deſtruction, when Leopold count Daun took upon him the command of the remains of M. Brown's army. This general had arrived within a few miles of Prague the day after the great battle. He immediately collected the ſcattered fugitives with the greateſt diligence, and retired with them to a ſtrong poſt in the neighbourhood, from whence he gave the troops in Prague hopes of a ſpeedy relief. It was now the king of Pruſſia's buſineſs, either to have attempted to make himſelf maſter of the city by one deſperate effort, or entirely to have abandoned the enterpriſe, and driven count Daun from his poſt before his troops had recovered from the terror of their late defeat; but, by attempting to do both, he rendered himſelf incapable of doing either. Though the army of count Daun already amounted to 60,000 men, and though they were ſtrongly entrenched, and defended by a vaſt train of artillery, his majeſty thought proper to ſend no more than 32,000 men. This body made the arduous attempt on the 18th of June; but though they did all that human courage and conduct could do, and though the king himſelf at laſt charged at the head of his cavalry, the Pruſſians were driven out of the field with great loſs. This engagement was named *the battle of Colin*.

26 Defeats the Pruſſians at Colin.

27 Siege of Prague raiſed.

The firſt conſequence of the battle of Colin was, that the king of Pruſſia was obliged to raiſe the ſiege of Prague; ſoon after which, he was obliged to quit Bohemia, and take refuge in Saxony. The Auſtrians haraſſed him as much as poſſible; but, notwithſtanding their great ſuperiority, their armies were not in a condition to make any deciſive attempt upon him, as the frontiers of Saxony abounded with ſituations eaſily defended. In the mean time, the Ruſſians, who had hitherto been very dilatory in their motions, began to exert themſelves, and enter Ducal Pruſſia, under M. Apraxin and Fermor, where they committed innumerable cruelties and exceſſes. A large body of Auſtrians entered Sileſia, and penetrated as far as Breſlau. Then they made a turn backwards, and beſieged Schweidnitz. Another body entered Luſatia, and made themſelves maſters of Zittau. An army of 22,000 Swedes entered Pruſſian Pomerania, took the towns of Anclam and Demmein, and laid the whole country under contribution. The French, too, being freed from all reſtraint by the capitulation of the duke of Cumberland at Cloſter Seven §, made their way into Halberſtadt and the Old Marche of Brandenburg, firſt exacting contributions, and then plundering the towns. The army of the empire, being reinforced by that of the prince de Soubiſe, after many delays, was on full march to enter Saxony, which left the Auſtrians at liberty to exert the greateſt part of their force in the reduction of Sileſia. General Haddick penetrated through Luſatia, paſſed by the Pruſſian armies, and ſuddenly appeared before the gates of Berlin, which city he laid under contribution. He retired on the approach of a body of Pruſſians; yet he ſtill found means to keep ſuch a poſt as interrupted the king's communication with Sileſia. The deſtruction of the king of Pruſſia therefore now ſeemed inevitable. Every exertion which he had made, though brave and well-conducted, had been unſucceſsful. His general Lehwald, who oppoſed the Ruſſians, had orders to attack them at all events. He obeyed his orders; and with 30,000 men attacked 60,000 of the enemy ſtrongly entrenched at a place called *Norkitten*. The Pruſſians behaved with the greateſt valour; but after having killed five times more of the enemy than they themſelves loſt, they were obliged to retire, though more formidable after their defeat than the Ruſſians after their victory. The king, in the mean time, exerted himſelf on every ſide, and his enemies fled everywhere before him; but whilſt he purſued one body, another gained upon him in ſome other part, and the winter came on faſt, while his ſtrength decayed, and that of his adverſaries ſeemed to increaſe on every quarter.

28 Berlin laid under contribution.

29 Lehwald a Pruſſian general defeated by the Ruſſians.

The Pruſſian monarch, however, though diſtreſſed, did not abandon himſelf to deſpair, or loſe that wonderful preſence of mind which has ſo eminently diſtinguiſhed him in all his military enterpriſes. He induſtriouſly delayed a deciſive action till the approach of winter; but at laſt, after various movements, on November 5. 1757, he met at Roſbach with the united army of his enemies commanded by the prince of Saxe Hilburghauſen and the prince de Soubiſe. The allied army amounted to 50,000 men complete; but moſt of the troops of the Circles were new-raiſed, and many of them not well affected to the cauſe. The Pruſſians did not exceed 25,000 men; but they were ſuperior to any troops in the world, and were inſpired, by the preſence of their king, with the moſt enthuſiaſtic valour. The Auſtrians were defeated with the loſs of 3000 killed, eight generals, 250 officers of different ranks, and 6000 private ſoldiers, taken priſoners, while night alone prevented the total deſtruction of the army.

30 The king gains a great victory at Roſbach.

By this battle the king was ſet free on one ſide; but this only gave him an opportunity of renewing his labours on another. The Auſtrians had a great force, and now began to make a proportionable progreſs in Sileſia. After a ſiege of 16 days, they had reduced the ſtrong fortreſs of Schweidnitz, and obliged

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§ See BRITAIN, n° 441.

31 Schweidnitz taken by the Auſtrians.

32 Battle with the prince of Bevern.

the Pruſſian garriſon of 4000 men to ſurrender priſoners of war. Hearing then of the victory at Roſbach, and that the king of Pruſſia was in full march to relieve Sileſia, they reſolved to attack the Prince of Bevern in his ſtrong camp under the walls of Breſlau. They attacked the Prince's army on November 22d; but their attack was ſuſtained with the greateſt reſolution. The ſlaughter of the Auſtrians was prodigious. A great part of the enemy had retired from the field of battle, and the reſt were preparing to retire, when all at once the Pruſſian generals took the ſame reſolution. Their army had ſuffered much in the engagement, and they became apprehenſive of a total defeat in caſe their entrenchments ſhould be forced in any part; for which reaſon they quitted their ſtrong poſt, and retired behind the Oder. Two days after, the prince of Bevern, going to reconnoitre without eſcort, attended only by a groom, was taken priſoner by an advanced party of Croats, a ſmall body of whom had croſſed the Oder.

33 Breſlau taken by the Auſtrians.

34 Garriſon of Schweidnitz recover their liberty.

On this the town of Breſlau immediately ſurrendered; where, as well as at Schweidnitz, the Auſtrians found great quantities of proviſions, ammunition, and money. All Sileſia was on the point of falling into their hands, and the Pruſſian affairs were going into the utmoſt diſtraction, when the king himſelf by a moſt rapid march paſſed through Thuringia, Miſnia, and Luſatia, in ſpite of the utmoſt efforts of the generals Haddick and Marſhal, who were placed there to oppoſe him; and, entering Sileſia on the 2d of December, joined the prince of Bevern's corps, who repaſſed the Oder to meet him. The garriſon of Schweidnitz, who, as we have already obſerved, had been made priſoners of war, alſo joined the king's army unexpectedly; and their preſence contributed not a little, notwithſtanding the ſmallneſs of their number, to raiſe the ſpirits of the whole army. They had ſubmitted to the capitulation with the greateſt reluctance; but as the Auſtrians were conducting them to priſon, they happened to receive intelligence of the victory at Roſbach: on which they immediately roſe on the eſcort that conducted them, and entirely diſperſed it; and afterwards marching in ſuch a direction as they thought might moſt readily lead them to their king, they accidentally fell in with his army.

35 Count Daun defeated by the king of Pruſſia at Leuthen.

His Pruſſian majeſty now approached Breſlau; on which the Auſtrians, confiding in their ſuperiority, (for they exceeded 70,000, while the Pruſſians ſcarce amounted to 36,000), abandoned their ſtrong camp, the ſame which the prince of Bevern had formerly occupied, and advanced to give him battle. The king did not intend by any means to diſappoint them, but advanced on his part with the greateſt celerity. The two armies met on December 5th, near the village of Leuthen. Count Daun made the beſt diſpoſitions poſſible. The ground occupied by his army was a plain, with ſmall eminences in ſome parts. Theſe eminences they ſurrounded with artillery; and as the ground was alſo interſperſed with thickets, they ſought to turn theſe likewiſe to their advantage. On their right and left were hills, on which they planted batteries of cannon. The ground in their front was interſected by many cauſeways; and to make the whole more impracticable, the Auſtrians had felled a great number of trees, and ſcattered them in the way. It was almoſt impoſſible at the beginning of the engagement for the Pruſſian cavalry to act, on account of theſe impediments; but, by a judicious diſpoſition made by the king himſelf, all difficulties were overcome. His majeſty had placed four battalions behind the cavalry of his right wing; foreſeeing that General Nadaſti, who was placed on the enemy's left with a corps de reſerve, deſigned to attack him in flank. It happened as he had foreſeen: that general's cavalry attacked the Pruſſian right wing with great fury; but he was received with ſuch a ſevere fire from the four battalions, that he was obliged to retire in diſorder. The king's flank then, well covered and ſupported, was enabled to act with ſuch order and vigour as repulſed the enemy. The Auſtrian artillery was alſo ſilenced by that of the Pruſſians; however, the Auſtrians continued to made a gallant reſiſtance during the whole battle. After having been once thrown into diſorder, they rallied all their forces about Leuthen, which was defended on every ſide by entrenchments and redoubts. The Pruſſians attacked them with the utmoſt impetuoſity, and at laſt became maſters of the poſt; on which the enemy fled on all ſides, and a total rout enſued. In this battle the Auſtrians loſt 6000 killed on the ſpot, 15,000 taken priſoners, and upwards of 200 pieces of cannon.

36 Breſlau retaken.

37 Swedes driven out of Pomerania.

The conſequences of this victory were very great. Breſlau was immediately inveſted, and ſurrendered on December 29th; the garriſon, amounting to 13,000 men, were made priſoners of war. The blockade of Schweidnitz was formed as cloſely as the ſeaſon of the year would permit; while detached Pruſſian parties over-ran the whole country of Sileſia, and reduced every place of leſs importance. The Ruſſians, who had ravaged and deſtroyed the country in ſuch a manner that they could not ſubſiſt in it, thought proper to retire out of the Pruſſian dominions altogether. Thus General Lehwald was left at liberty to act againſt the Swedes; and them he quickly drove out of Pruſſian Pomerania; the whole of which country he not only recovered, but alſo ſome part of Swediſh Pomerania. Thus the duchy of Meclenburg being left quite expoſed, the king took ample vengeance on it by exacting the moſt ſevere contributions of men and money. To complete this monarch's good fortune alſo, the French, who had retired after the battle of Roſbach, were now oppoſed by the Hanoverians under Prince Ferdinand, who kept them ſo well employed, that, during the reſt of the war, the king of Pruſſia had no more trouble from them. See BRITAIN, n° 442.

38 Schweidnitz retaken.

The beginning of the year 1758 was favourable to the arms of his Pruſſian majeſty. On the 3d of April he commenced his operations againſt Schweidnitz, and puſhed the ſiege ſo vigorouſly, that the place ſurrendered in 13 days. He then diſpoſed his forces in ſuch a manner as might beſt guard his dominions againſt his numerous enemies. For this purpoſe count Dohna commanded a body of troops on the ſide of Pomerania; another conſiderable body was poſted between Wohlau and Glogau, in order to cover Sileſia from the Ruſſians, in caſe they ſhould make their inroad that way. An army, in a little time after, was formed in Saxony, commanded by the king's brother Prince Henry. This army conſiſted of 30 battalions and 45 ſquadrons, and was deſigned to make head againſt the army of the empire; which, by great ef-

39 The king beſieges Olmutz without ſucceſs.

ſorts made during the winter, and the junction of a large body of Auſtrians, was again in a condition to act. Between all theſe armies a ready communication was kept up by a proper choice of poſts. After the reduction of Schweidnitz, the king having made a ſhow of invading Bohemia, ſuddenly burſt into Moravia, where in a ſhort time he made himſelf maſter of the whole country, and on the 27th of May laid ſiege to Olmutz the capital. Of this M. Daun was no ſooner informed, than he took his route to Moravia through Bohemia: and, though he was not in a condition to riſk a battle, nor indeed would have done ſo unleſs he had had a very conſiderable advantage; yet, by placing himſelf in a ſtrong ſituation where he could not be attacked, by haraſſing the king's troops and cutting off their convoys, he at laſt obliged him to abandon the enterpriſe. The king, however, who frequently owed a good part of his ſucceſs to the impenetrable ſecrecy with which he covered all his deſigns, gave not the leaſt hint of his intention to raiſe the ſiege of Olmutz. On the contrary, the very day before the ſiege was raiſed, the firing continued as briſk as ever; but in the night (July 1.) the whole army took the road to Bohemia in two columns, and gained an entire march upon the Auſtrians. Thus, notwithſtanding the utmoſt efforts of his enemies, the Pruſſian army reached Bohemia with very little moleſtation. Here he ſeized upon a large magazine at Lieutomiſſel; defeated ſome corps of Auſtrians who had attempted to interrupt his progreſs; and arrived at Konigſgratz, of which he took poſſeſſion, after driving from it 7000 Auſtrians who were entrenched there. This city and ſeveral other diſtricts he laid under contribution: but ſoon after entered Sileſia, and marched with the utmoſt rapidity to encounter the Ruſſians, who had at that time united their forces under generals Brown and Fermor, entered the New Marche of Brandenburg, and laid ſiege to Cuſtrin.

40 The Ruſſians beſiege Cuſtrin.

41 But are defeated at Zorndoff.

The king arrived at this city at a very critical period. The Ruſſians had laid ſiege to it on the 15th of Auguſt; and though they were not well ſkilled in managing artillery, yet, by furious and unremitting diſcharges at random, they threw in ſuch a number of bombs and red-hot balls, that the town was ſoon on fire in every quarter. Some of the wretched inhatants were burned; others buried in the ruins of their houſes, or killed by the balls which fell like hail in the ſtreets; while many of the ſurvivors abandoned their habitations, and fled out of the town on that ſide where it was not inveſted. The governor did every thing for the defence of the place; but as the walls were built after the old manner, it was impoſſible that the town could have made a defence for any length of time, eſpecially as the principal magazine of the beſieged had been blown up. The avenger of all theſe injuries, however, was now at hand. The king came in ſight of the Ruſſians on the 25th of Auguſt, after a march of 56 days, and beheld the country everywhere deſolated, and the villages in flames by the depredations of his cruel enemy, who had raiſed the ſiege at his approach, and retired towards a neighbouring village named *Zorndorff*. At nine o'clock in the morning, a moſt terrible fire of cannon and mortars poured deſtruction on the right wing of the Ruſſian army for two hours without intermiſſion. The ſlaughter was ſuch as might have been expected; but the Ruſſians kept their ground with aſtoniſhing reſolution, new regiments ſtill preſſing forward to ſupply the places of thoſe that fell. When the firſt line had fired away all their charges, they ruſhed forward on the Pruſſians with their bayonets; and all at once theſe brave troops, though encouraged by the preſence of their king, gave way and fled before an enemy already half defeated. The Ruſſian generals ought now to have attacked with their cavalry the diſordered infantry of their enemies, which would have completed the defeat, and in all probability given the finiſhing ſtroke to the king of Pruſſia's affairs. This opportunity, however, they loſt: but the king was not ſo negligent; for, by a very rapid and maſterly motion, he brought all the cavalry of his right wing to the centre, and falling on the Ruſſian foot uncovered by their horſe, and even diſordered by their own ſucceſs, they puſhed them back with moſt miſerable ſlaughter, at the ſame time that the repulſed battalions of infantry, returning to the charge, and exaſperated at their late diſgrace, rendered the victory no longer doubtful. The Ruſſians were now thrown into the moſt dreadful confuſion. The wind blew the duſt and ſmoke into their faces, ſo that they could not diſtinguiſh friends from foes; they fired on each other, plundered their own baggage which ſtood between the lines, and intoxicated themſelves with brandy: the ranks fell in upon one another; and, being thus crammed together into a narrow ſpace, the fire of the Pruſſians had a full and dreadful effect, while their enemies kept up only a ſcattered and ineffectual fire, generally quite over their heads. Yet even in this diſmal ſituation the Ruſſians did not fly; but ſuffered themſelves to be ſlaughtered till ſeven at night, when their generals having cauſed an attack to be made on the Pruſſian right wing, the attention of the enemy was drawn to that quarter, and they had time to retire a little from the field of battle to recover their order.

In this engagement, which was called the *battle of Zorndorff*, the Ruſſians loſt 21,529 men, while that of the Pruſſians did not exceed 2000. A vaſt train of artillery was taken, together with the military cheſt, and many officers of high rank. The conſequence was, that the Ruſſian army retreated as far as Landſperg on the frontiers of Poland, and the king was left at liberty to march with his uſual expedition to the relief of prince Henry of Saxony.

42 Operations of Count Daun.

The Prince was at this time ſorely preſſed by M. Daun. As ſoon as the king had left Bohemia in the manner already related, M. Daun, conſidering that it would have been to no purpoſe to follow him, reſolved to turn his arms towards Saxony. Towards that country, therefore, he took his route through Luſatia, by Zittau, Gorlitz, and Bautzen. On the 3d of September he inveſted the ſtrong fortreſs of Sonneſtein; which unaccountably ſurrendered, after a ſingle day's reſiſtance, to one of his generals named *Macguire*. He then began to favour the operations of General Laudohn, who had advanced through the Lower Luſatia to the confines of Brandenburg; and, by drawing the attention of the Pruſſian forces which were left in Sileſia to the northward of that duchy, he facilitated the progreſs of the generals Harſch and De Ville in the ſouthern parts. He then propoſed that prince Henry ſhould be attacked by the army of the empire, while that of

43 Rendered abortive by the king of Pruſſia;

the Auſtrians ſhould paſs the Elbe, and, falling at the ſame time on the Pruſſians, ſecond the attack of the Imperialiſts, and cut off the retreat of their enemies from Dreſden. The ſudden appearance of the king of Pruſſia, however, put an end to this plan; general Laudohn abandoned, all his conqueſts in lower Luſatia, and retired towards M. Daun, while that general himſelf retired from the neighbourhood of Dreſden as far as Zittau. The army of the empire only kept its ground; poſſeſſing itſelf of the ſtrong poſt at Pirna, formerly mentioned, but did not undertake any thing. As for the Swedes, who had directed their motions by thoſe of the Ruſſians, they no ſooner heard of the victory of Zorndorff, than they retreated with much more expedition than they had advanced.

Thus the king of Pruſſia's affairs ſeemed to be pretty well retrieved, when by one fatal piece of negligence he was brought to the verge of ruin. M. Daun had poſſeſſed himſelf of an advantageous camp at Stolphen, by which he preſerved a communication with the army of the empire. On the other hand, the king of Pruſſia, having taken poſſeſſion of an important poſt at Bautzen, extended his right wing to the village of Hochkirchen, by which he preſerved a communication with his brother Prince Henry, protected Brandenburg, and was better ſituated than he could be anywhere elſe for throwing ſuccours into Sileſia. The two armies kept a watchful eye on the motions of each other; and as the principal aim of M. Daun was to cut off the king's communication with Sileſia, and of the king to cut off M. Daun's communication with Bohemia, a battle ſeemed inevitable, though great danger ſeemed to await that party who ſhould begin the attack.

44 Who is ſurpriſed and defeated at Hochkirchen.

In this critical poſture of affairs, the Auſtrian general formed a deſign of attacking the Pruſſian camp in the night. In what manner he came to ſurpriſe ſuch a vigilant enemy, has never been accounted for; but that ſuch a ſurpriſe was actually accompliſhed on the 14th of October, is certain. In the dead of the preceding night, the Auſtrian army began to march in three columns towards the camp of the king of Pruſſia: and though the night was exceedingly dark, and they had a conſiderable way to go, they all arrived at the ſame time, in ſafety, without being diſcovered, and without the leaſt confuſion; and at five in the morning began a regular and well-conducted attack. The Pruſſians were in a moment thrown into confuſion; Marſhal Keith, one of their beſt generals, received two muſket-balls, and fell dead on the ſpot. Prince Francis of Brunſwick had his head ſhot off by a cannon-ball as he was mounting his horſe; and every thing ſeemed to announce the total deſtruction of the army. Still, however, the king preſerved his wonderful preſence of mind, which indeed he never appears to have loſt on any occaſion. He ordered ſome detachments from his left to ſupport his right wing; but the moment that theſe orders were received, the left itſelf was furiouſly attacked. General Ketzow, who commanded in that quarter, repulſed the Auſtrians with difficulty, and was not able to afford any conſiderable aſſiſtance to the right; which alone was obliged to ſuſtain the weight of the grand attack. The Auſtrians, in the beginning of the engagement, had driven the Pruſſians out of the village of Hochkirchen; and as the fate of the day depended on the poſſeſſion of that poſt, the hotteſt diſpute was there. The Pruſſians made three bloody and unſucceſsful attacks on the village; on the fourth they carried it; but the Auſtrians continually pouring in freſh troops, at laſt drove them out with prodigious ſlaughter on all ſides. The king then ordered a retreat, which was conducted in good order, without being purſued; however, this bloody action coſt him 7000 men, together with a great number of cannon. The Auſtrians computed their own loſs at 5000.

His Pruſſian majeſty, having thus happily eſcaped ſuch imminent danger, took every poſſible meaſure to prevent the enemy from gaining any conſiderable advantage from his defeat. Perceiving that the only advantage they wiſhed to derive from it was to cover the operations of their armies in Sileſia, and that he had now nothing to fear on the ſide of Saxony, he largely reinforced his own army from that of Prince Henry, and haſtened into Sileſia, in order to raiſe the ſiege of Neiſs, which had been completely inveſted on the 4th of October. On the 24th of that month, therefore, he quitted his camp, and, making a great compaſs, to avoid obſtructions from the enemy, arrived in the plains of Gorlitz. A body of the Auſtrians had in vain attempted to ſecure this poſt before him, and ſome who arrived after him were defeated with the loſs of 800 men. From this place the king purſued his march with the utmoſt diligence; but was followed by general Laudohn, at the head of 24,000 men, who conſtantly hung on his rear, and haraſſed his army. The king, however, knowing the importance of his expedition, continued his march without interruption, and ſuffered his antagoniſt to obtain many little advantages without moleſtation. Daun, however, not content with the oppoſition given by Laudohn, ſent a large body of horſe and foot by another route to reinforce the generals Karſch and De Ville, who had formed the ſiege of Neiſs and the blockade of Coſel, while he himſelf paſſed the Elbe, and advanced towards Dreſden.

45 Suburbs of Dreſden burnt;

All theſe precautions, however, were of little avail. The generals Karſch and De Ville, notwithſtanding their reinforcement, no ſooner heard of the king of Pruſſia's approach, than they raiſed the ſiege of both places, and retired, leaving behind them a conſiderable quantity of military ſtores. The end of the Pruſſian monarch's march being thus accompliſhed, he inſtantly returned by the ſame way he came, and haſtened to the relief of Saxony, the capital of which (Dreſden) was in great danger from Marſhal Daun. The place was but indifferently fortified, and garriſoned only by 12,000 men; ſo that it could not promiſe to hold out long againſt a numerous and well-appointed army. It was beſides commanded by a large ſuburb, of which, if once the enemy got poſſeſſion, all defence of the city muſt then be vain. For this reaſon M. Schmettau, the Pruſſian governor, determined to ſet theſe ſuburbs on fire, which was actually done November 10th, with an incredible loſs to the inhabitants, as in the ſuburbs were carried on moſt of thoſe valuable manufactures which render the city of Dreſden remarkable. This diſappointed the deſigns of M. Daun; but, though the action was agreeable to the laws of war, and had been executed with all the caution and humanity of which ſuch an action was capable, yet the Auſtrians exclaimed againſt it as a piece of the moſt unprovoked and wanton cruelty recorded in hiſtory.

46 Saxony oppreſſed by the king of Pruſſia.

After the king of Pruſſia had approached Dreſden, all the Auſtrian armies retired into Bohemia, where they took up their winter-quarters, as the king of Pruſſia did in Saxony. This unhappy country he ſaid he would now conſider as his own by right of conqueſt. But inſtead of treating the conquered people as his lawful ſubjects, he oppreſſed them in all poſſible ways, by levying the moſt ſevere and exorbitant contributions, ſurrounding the exchange with ſoldiers, and confining the merchants in narrow lodgings on ſtraw-beds, till they drew upon their correſpondents for ſuch ſums as he wanted.

In 1759, as early as the 23d of February, the Pruſſians commenced their military operations. General Woberſow marched with a body of troops into Poland, where he deſtroyed ſeveral very large magazines belonging to the Ruſſians, and returned into Sileſia without any loſs on the 18th of April. In the mean time, by ſome movements of the king of Pruſſia himſelf, the greateſt part of the Auſtrian troops had been drawn towards the frontiers of Sileſia. Prince Henry immediately took advantage of this opening, and on the 15th of April entered Bohemia with his army divided into two columns. One, commanded by himſelf, marched towards Peterſwade; the other, under general Hulſen, paſſed by the towns of Paſberg and Commottau. That commanded by Prince Henry himſelf penetrated as far as Loboſchutz and Leitmeritz; the enemy flying everywhere before them, and burning or abandoning the vaſt magazines which they had amaſſed in theſe parts. The body under general Hulſen had a more active employment. A ſtrong paſs at Paſberg was defended by a conſiderable body of Auſtrians. General Hulſen, having conducted his cavalry by another way in ſuch a manner as to fall directly on their rear, attacked them in front with his infantry, drove them out of their intrenchments, and totally defeated them with the loſs of a great number killed, and 2000 taken priſoners, while that of the Pruſſians did not exceed 70 in killed and wounded. After this exploit they returned into Saxony, with hoſtages for the contributions which they had largely exacted during the courſe of their expedition.

47 Bohemia invaded by Prince Henry.

48 A body of Auſtrians defeated by General Hulſen.

Some other ſucceſſes obtained by Prince Henry, cleared the country of Franconia of his enemies; but now the approach of the Ruſſians ſeemed once more to bring the affairs of the king of Pruſſia to a criſis. Notwithſtanding the deſtruction of their magazines, they had continued to advance into Sileſia, where they were oppoſed by Count Dohna; but as the troops he had with him were very far inferior to his enemies, he found it impoſſible to do more, at leaſt with any appearance of ſucceſs, than to obſerve their motions and haraſs them on their march. But this was ſo diſpleaſing to the king, that he diſgraced this general, and appointed Wedel to ſucceed him, with orders to attack the Ruſſians at all events. To enable him, however, in ſome meaſure to comply with this deſperate order, he ſent him ſome reinforcements, which brought his army up to near 30,000. With theſe, on the 23d of July 1759, General Wedel attacked 70,000 Ruſſians poſted in the moſt advantageous manner at Zulichau, and defended by a numerous artillery. Though the Pruſſians marched on to certain deſtruction and diſgrace, they ſuſtained the attack for a long time with unparalleled reſolution. At laſt, however, they gave way, and were obliged to retire with the loſs of 4700 killed or taken priſoners, and 3000 wounded.

49 Pruſſians defeated at Zulichau.

50 The Ruſſians take Croſſen and Frankfort on the Oder.

51 King of Pruſſia defeated by the Ruſſians at Cunnerſdorf.

The conſequences of this victory were, that the Ruſſians penetrated into the king's territories, and took poſſeſſion of the towns of Croſſen and Frankfort on the Oder, which made it abſolutely neceſſary for the king to come in perſon to oppoſe them. Accordingly, on the 4th of Auguſt, he joined Wedel with a conſiderable body of forces, having left the greateſt part of his army in Saxony under Prince Henry. But as Marſhal Daun had ſent a body of 12,000 horſe and 8000 foot under General Laudohn to the aſſiſtance of the Ruſſians, the king ſtill found himſelf unable to fight them; as, with this and ſome other reinforcements, their army now amounted to upwards of 90,000. He therefore recalled General Finck, whom he had ſent into Saxony with 9000 men; but, with all his reinforcements, it was found impoſſible to augment his army to 50,000 complete. His ſituation, however, was now ſo critical, that a battle was unavoidable; and therefore, on the 12th of Auguſt, with this inferiority of number, the king attacked his enemies ſtrongly intrenched, and defended by a prodigious number of cannon. In this action, his principal effort was againſt the left wing of the Ruſſian army. He began the attack, according to cuſtom, with a heavy cannonade; which having produced the deſired effect, he attacked that wing with ſeveral battalions diſpoſed in columns. The Ruſſian intrenchments were forced with great ſlaughter, and 72 pieces of cannon were taken. But ſtill there was a defile to be paſſed, and ſeveral redoubts which covered the village of Cunnerſdorf to be maſtered. Theſe were attacked with the ſame reſolution, and taken one after another. The enemy made another ſtand at the village, and endeavoured to preſerve their ground there by puſhing forward ſeveral battalions of horſe and foot: but this alſo proved unſucceſsful; they were driven from poſt to poſt quite to the laſt redoubts. For upwards of ſix hours the Pruſſians were ſucceſsful, and everywhere broke the enemy with prodigious ſlaughter; drove them from almoſt all the ground they had occupied before the battle, took more than half their artillery, and ſcarce any thing ſeemed wanting to make the victory complete. In theſe circumſtances, the king wrote the following billet to the queen: "Madam, we have beat the Ruſſians from their intrenchments. In two hours expect to hear of a glorious victory." Of this victory, however, he deprived himſelf, by an exceſſive eagerneſs for conqueſt. The enemy, defeated almoſt in every quarter, found their left wing, ſhattered as it was, to be more entire than any other part of their army. Count Soltikoff, the Ruſſian general, therefore aſſembled the remains of his right wing, and, gathering as many as he could from his centre, reinforced the left, and made a ſtand at a redoubt which had been erected on an advantageous eminence in a place called *the Jews burying-ground.* All the king's generals are ſaid to have been of opinion, that he ought to allow the Ruſſians the peaceable poſſeſſion of this poſt. Their army had already ſuffered ſo much, that it would have been impoſſible for them to have attempted any enterpriſe of conſequence after the battle; but their artillery was ſtill numerous, the poſt very ſtrong, and the Pruſſian troops greatly fatigued. Theſe reaſons for a few moments had ſome weight with the king: but the natural impetuoſity of his temper getting the better of his reaſon, he led on his wearied troops again and again; till at laſt, when their ſtrength was in a manner totally exhauſted, they were attacked and utterly routed by the Auſtrian and Ruſſian cavalry, the former of which had hitherto remained quite inactive, and were therefore quite freſh, and irreſiſtible by the enfeebled Pruſſians. The night, and the prudent uſe of ſome eminences, prevented the total deſtruction of the army; however, their loſs amounted to 20,000 men killed and wounded. The king, when he found the victory totally loſt, ſent another billet to the queen, expreſſed in the following manner: "Remove from Berlin with the royal family; let the archives be carried to Potſdam; the town may make conditions with the enemy."

Immediately after this defeat, the king ſet himſelf about repairing his loſſes with the utmoſt diligence. In a few days every thing was again put in order in his camp. He replaced his artillery from Berlin; recalled General Klieſt with 5000 men from Pomerania; detached 6000 from his own army to the defence of Saxony; and with the remainder put himſelf between the Ruſſians and Great Glogau, covering that city which had been the chief object of their deſigns; and in ſhort, notwithſtanding their victory, obliged them to return to Poland without accompliſhing any thing beſides the carnage at Cunnerſdorff.

52 General Finck with 12,000 Pruſſians ſurrenders to the Auſtrians.

The misfortunes of the Pruſſian monarch, however, were not at an end. Prince Henry indeed, by a moſt extraordinary and well-conducted march, entered Saxony, which was now totally over-run by the armies of the enemy. At the ſame time, ſtrong detachments having been ſent into that country under generals, Finck and Wunſch, the whole was in a ſhort time recovered except Dreſden. Towards this place Marſhal Daun retired, and in all probability would ſoon have been obliged to leave Saxony entirely. But the king's impatience could not be ſatisfied without cutting off his retreat, and forcing him to a battle; for which purpoſe he ſent General Finck with upwards of 12,000 men according to the Pruſſian account, but 20,000 according to the Auſtrians, to ſeize ſome paſſes through which M. Daun could only take his route towards Bohemia. This commiſſion was executed with great exactneſs; but the Pruſſian general, having probably advanced too far into theſe defiles, and neglected to preſerve a communication with the main army, gave his enemy an opportunity of ſurrounding him, and at laſt forcing him and his whole army to ſurrender priſoners of war. This diſaſter was ſoon after followed by another. General Durceke was poſted at the right of the Elbe, oppoſite to Meſſen; but on the approach of a large body of Auſtrians, they prepared to retreat over the river into a place where they hoped to be more ſecure. But having been obliged by an hard froſt to withdraw their bridge of boats, a thaw ſupervened, when they attempted to lay a bridge of pontoons, ſo that they were again obliged to have recourſe to their boats. In this ſituation, their rear-guard was attacked with great fury by the Auſtrians, and all the ſoldiers who compoſed it killed or taken. The loſs of the Pruſſians on this occaſion was computed at 3000 men.

53 Deſperate ſituation of the king of Pruſſia.

The year 1760 ſhowed the Pruſſian monarch in a more dangerous ſituation than he had ever yet experienced. Indeed his affairs now ſeemed to be altogether deſperate. His loſſes were not to be meaſured by the number of the killed or priſoners, but by armies deſtroyed or taken. Forty generals had died or been killed in his ſervice ſince the beginning of October 1756, excluſive of thoſe who were wounded or taken priſoners. This of itſelf would have been an irreparable loſs, had not the very wars which deſtroyed theſe furniſhed others equally capable of filling their places. But another deficiency, which could not be remedied, ſtill remained.—The king had, by his indefatigable induſtry and exertions, ſupplied all the deficiencies of men in his armies, but they were not the ſame men as before. The hardy veterans, with whom he had originally taken the field, were now no more, and their places were ſupplied by others who had neither the ſame experience nor diſcipline; ſo that now he was obliged to ſupply this deficiency by his own genius and heroiſm.

54 Pruſſians defeated at Landſhut.

But whatever abilities the Pruſſian monarch might poſſeſs, and though he undoubtedly exerted them to the utmoſt, it ſeemed only to be contending againſt fate, and his enemies gained ſtill greater and greater advantages. General Laudohn, with whom none but the king himſelf ſeems to have been able to cope, by a ſeries of artful movements, drew into a diſadvantageous ſituation M. Fouquet, one of the Pruſſian generals, with a ſtrong body of forces. Perceiving it impoſſible for them to eſcape, Laudohn then made a violent attack on their intrenchments in the dead of the night of June 23d. The Pruſſians made a gallant defence, but at laſt were all killed or taken priſoners except about 300. Of the Pruſſians were killed 4000, and 7000 taken priſoners; 58 pieces of cannon, and a great number of colours, were alſo loſt. The victory, however, was dear bought; for the Auſtrians loſt above 12,000 men in killed and wounded; whom, however, they could better ſpare than the Pruſſians, on account of their numbers.—This action was called *the battle of Landſhut*.

55 Glatz taken by the Auſtrians.

Baron Laudohn failed not to improve this victory to the utmoſt. He inſtantly turned back from Landſhut, and fell upon the city of Glatz; which he took in a very ſhort time, with the garriſon who defended it, conſiſting of 2000 men. In this place were found 101 pieces of braſs cannon, with immenſe quantities of proviſions and military ſtores. From thence he marched againſt Breſlau, and immediately inveſted it. But, in the mean time, the king of Pruſſia, whoſe motions had been all this time counteracted by M. Daun in Saxony, marched with his uſual rapidity towards Sileſia. By this means he drew M. Daun out of Saxony; and indeed the Auſtrian general uſed ſuch expedition, that he gained two full days on the king. This was no ſooner known to his Pruſſian majeſty, than he returned with the ſame expedition that he had advanced, and ſat down before Dreſden. Of this M. Daun ſoon received intelligence, and returned alſo. In the mean time, however, the buildings of the city were terribly ſhattered by the king's cannon and bombs which continually played on it. His endeavours, however, proved ineffectual to reduce it before the arrival of M. Daun. The ſiege had been begun on the 13th of July, and on the 19th M. Daun appeared within a league of Dreſden. The

56 Dreſden beſieged but without ſucceſs by the king of Pruſſia.

Pruſſians then redoubled their efforts. They had that day received reinforcements of heavy cannon and mortars, with which they battered the place inceſſantly. The cathedral church, New Square, ſeveral principal ſtreets, and ſome palaces, and the noble manufactory of porcelain, were entirely deſtroyed. The ſiege was continued till the 22d: but, on the night of the 21ſt, M. Daun had thrown 16 battalions into the city; which rendered it impoſſible for the king to continue longer before it with any proſpect of ſucceſs. He therefore raiſed the ſiege, and retired without moleſtation, though there were three conſiderable armies of the enemy in the neighbourhood. Breſlau was fiercely bombarded by Laudohn, but the approach of Prince Henry obliged him to deſiſt from his enterpriſe on the 5th of Auguſt.

57 Three Auſtrian generals join their forces againſt him.

But, in the mean time, the fortune of the king ſeemed likely to be terminated by one fatal ſtroke. Finding it impoſſible for him to carry on a defenſive war, he marched towards Sileſia with ſuch aſtoniſhing rapidity, that before the middle of Auguſt he had advanced 200 miles, leaving Marſhal Daun with his army far behind him. This expedition he undertook in order to engage General Laudohn before he could have time to effect a junction with Daun and Lacy, another Auſtrian general; which triple union ſeemed to threaten him with unavoidable deſtruction at once. This, however, he found it impoſſible to prevent: and the three armies, when joined, formed a moſt tremendous line of encampments, extending no leſs than 30 Engliſh miles; at the ſame time that every one of their poſts was ſtrong, and the communication between them eaſy. The king was ſtrongly encamped at Lignitz; and for ſeveral days employed all his military ſkill in attempting to induce one of the bodies to detach itſelf from the reſt, or to attack them at ſome diſadvantage; but without effect. At laſt, the Auſtrian generals, having maturely weighed all circumſtances, reſolved to attack the king's camp itſelf, ſtrong as it was; and Marſhal Daun, remembering the advantage he had gained at Hochkirchen by an attack in the night-time, reſolved to follow the ſame plan now. The plan therefore was laid in the following manner. The whole army, as ſoon as it ſhould begin to grow dark, was to march from their ſeveral poſts to ſuch ſituations as were marked out for each corps: they were to ſtrike their tents, but yet to keep up the fires in their camps, and to have the drums beat the tattoo as uſual, by which means they had a probability of ſurpriſing the enemy; or if not, they judged it abſolutely impoſſible for him to eſcape them, though he ſhould be ever ſo much on his guard. In what manner the king of Pruſſia became acquainted with this plan, is not known. His friends attributed it to his own penetration and knowledge of the ſtratagems of war; the Auſtrians, to intelligence given him by deſerters. But, in whatever way he became acquainted with this deſign, it is certain that he took the moſt effectual methods of preventing it. As the Auſtrian plan was to ſurround his camp, and this could not be done without the diviſion of their army which he had ſo long deſired, he reſolved to intercept one of the parties; and if that ſhould be diſabled from acting, he could then more eaſily deal with the other two. Therefore, in the very evening calculated for the deciſive attack on his camp, he quitted it with the utmoſt privacy, and took an advantageous poſt on the road through which General Laudohn was to paſs. The nature of this poſt was ſuch, that at the ſame time that it ſtopped the progreſs of Laudohn in front, Daun would lie under great difficulties if he ſhould attempt his rear; at the ſame time that, for his further ſecurity, the king ſtrengthened the rear with ſeveral batteries. As ſoon as his army was drawn up, he divided it; leaving his right on the ground where it had been formed, to obſerve Marſhal Daun, and to maintain that poſt; whilſt with his left he turned in order to fall on the corps under General Laudohn. In the mean time, that commander, ignorant of the fate which was awaiting him, advanced with the utmoſt expedition towards the place which had been aſſigned him, in order to ſhare in the glory of deſtroying the Pruſſian monarch; when, at three in the morning, on the 15th of Auguſt, a thick fog which covered the ground, ſuddenly clearing up, diſcovered, like the opening of a great ſcene, the dreadful front of the Pruſſian army regularly embattled, and advantageouſly poſted. Laudohn, though ſurpriſed, made the beſt diſpoſitions that circumſtances would admit of, and an obſtinate engagement enſued; in which however, he was at laſt obliged to yield to the ſuperior ſkill of his adverſary, with the loſs of 10,000 killed, wounded, and priſoners, 82 pieces of cannon, and 23 pair of colours.

58 He defeats General Laudohn, and intimidates the Ruſſians.

The victory, though complete, gave but a partial relief to the king of Pruſſia. The moſt eſſential ſervice it did was the preventing of the Ruſſians from joining thoſe enemies which he already had. Count Czernichew had been advancing with 24,000 men, and had even paſſed the Oder; but was ſo intimidated by this news, that he inſtantly repaſſed that river on the ſame bridges which he had lately built, even though M. Daun ſent him a ſtrong body of troops in order to encourage him to advance. Soon after this battle, the king joined his brother Prince Henry at New Marche; and marched againſt Daun, who had begun to form the blockade of Schweidnitz, fell upon a corps under General Beck, made two battalions of Croats priſoners, and diſperſed the reſt, which obliged the enemy to abandon the enterpriſe they had juſt undertaken. About the ſame time, General Hulſen gained a conſiderable advantage over the Imperial army in Saxony, with very trifling loſs on his part, by which he effectually prevented them from cutting off his communication with the city of Torgau.

By theſe ſucceſſes the affairs of his Pruſſian majeſty ſeemed to revive: but there was no end of his enemies. The late manœuvres had drawn him ſo far into Sileſia, that his communication with Brandenburg was almoſt wholly cut off. The Ruſſian army, which after it had repaſſed the Oder began to move out of Sileſia, ſent forward a powerful detachment under Count Czernichew towards the march of Brandenburg. A body of 15,000 Auſtrians, under the generals Lacy and Brentano, and the whole united body of Auſtrians and Imperialiſts which acted in Saxony, began their march in concert with the Ruſſians, and propoſed to unite at the gates of Berlin. Theſe armies amounted to 40,000 men. To oppoſe this formidable power, general Hulſen called to his aſſiſtance general Werner, who had been ſent with a body of troops into Pomerania;

rania; but, after being joined by him, their united forces were found not to exceed 15,000 or 16,000 men. To attempt a defence of the capital with this force would have been little ſhort of madneſs: and therefore theſe commanders were obliged to leave Berlin to its fate; which indeed, conſidering the barbarity of the Ruſſians and the animoſity of the Auſtrians, ſeemed to be a dreadful one. However, by the powerful mediation of ſeveral foreign miniſters, the town obtained terms which were not altogether intolerable; but the magazines, arſenals, and founderies were deſtroyed, and an immenſe quantity of military ſtores ſeized with a number of cannon and other arms. The city was firſt obliged to pay 800,000 guilders, after which a contribution of 1,900,000 crowns was laid on: yet, notwithſtanding this, many violences were committed, and the king's palace was plundered and the furniture abuſed in a ſcandalous manner.

59
Berlin taken by the Auſtrians and Ruſſians.

60
Extreme embarraſſment of the king.

The combined armies ſtaid in Berlin only four days; dreading the ſevere vengeance of the king of Pruſſia, who they heard was advancing towards that place with great expedition. But ſo great were the embarraſſments which now attended that monarch, that it ſeemed abſolutely beyond human power to retrieve his affairs. The Imperialiſts, on their return from Berlin, having no army to oppoſe them, made themſelves maſters of Leipſic, Torgau, Meiſſen, and Wirtemberg; in which laſt city they found the grand magazine of the Pruſſians immenſely ſtored with proviſions, ammunition, &c. M. Stainville alſo, with a detachment from Broglio the French general's army, laid the city and duchy of Halberſtadt under contribution. In Eaſtern Pomerania, the Ruſſians had beſieged Colberg by ſea and land. In the Weſtern Pomerania, the Swedes advanced with great celerity, hoping to ſhare in the plunder of Berlin. In Sileſia, the king no ſooner began his march to the northward, than Laudohn advanced, and laid ſiege to the important fortreſs of Coſel; and, to complete this diſtreſs and embarraſſment, the king himſelf was attended at every ſtep by Count Daun with a ſuperior army well prepared to take every advantage.

In this deſperate ſituation the king, being joined by his generals Hulſen and prince Eugene of Wittemberg with the corps under their command, advanced up the Elbe, while M. Daun fell back to cover Leipſic and Torgau: but the latter, finding that the Pruſſians directed their march towards the Elbe, encamped within reach of Torgau; one part of his army extending to the Elbe, by which he was covered on that ſide, whilſt on the other he was covered by hills and woods, ſo that it was impoſſible to chooſe a more advantageous ſituation. The Pruſſian army did not amount to 50,000 men, whilſt that of the Auſtrians exceeded 86,000: yet ſuch were the unfortunate circumſtances of the king, that he was obliged to fight under all theſe diſadvantages; and therefore he cauſed his army to be informed, that he was now to lead them to a moſt deſperate attempt, that his affairs required it, and that he was determined to conquer or die. His ſoldiers unanimouſly declared that they would die with him.

61
He defeats Count Daun at Torgau.

The 3d of November 1760 was the day on which this important affair was decided. The king divided his forces into three columns. General Hulſen was to take poſt with one in a wood that lay on the left of the Auſtrian army, and had orders not to move until he found the reſt of the Pruſſians engaged. General Ziethen was to charge on the right; and the great attack in front was to be conducted by the king in perſon. His forces were diſpoſed in ſuch a manner, that either his right or left muſt take the enemy in rear and cloſe them in, ſo as to diſable them from undertaking any thing againſt the part where he intended to effect his principal attack. On the other hand, M. Daun perceiving the king to be ſerious in his deſign of fighting, to prevent confuſion, ſent all his baggage over the Elbe, acroſs which he threw three bridges in caſe a retreat ſhould be neceſſary. At the ſame time he cauſed Torgau to be evacuated; and then, extending his firſt line to a village called *Zinne* on the left, he ſtretched it to another called *Croſwitz* on the right; ſupporting the right of his ſecond line upon the Elbe. In this diſpoſition he was found, when, about two o'clock in the afternoon, the king began his attack. He was received by the fire of 200 pieces of cannon, which were diſpoſed along the Auſtrian front. The Pruſſians were thrice led on to the attack; but were every time repulſed and broken with terrible ſlaughter. The king at length commanded a freſh body of cavalry to advance, which at firſt compelled the Auſtrians to retire; but new reinforcements continually coming in, this cavalry was in its turn obliged to fall back, and the Pruſſians maintained themſelves with extreme difficulty, until General Ziethen, with the right wing, attacked the enemy in the rear, repulſed them, and poſſeſſed himſelf of ſome eminences which commanded the whole Auſtrian army. Encouraged by this ſucceſs, the Pruſſian infantry once more advanced, maſtered ſeveral of the enemy's intrenchments, and made way for a new attack of their cavalry, which broke in with irreſiſtible fury on the Auſtrians, and threw ſeveral bodies of them into irreparable diſorder. It was now about 9 o'clock, and of conſequence both armies were involved in thick darkneſs; yet the fire continued without intermiſſion, and the battalions with a blind rage diſcharged at one another without diſtinguiſhing friend from foe. M. Daun received a dangerous wound in the thigh, and was carried from the field, which probably haſtened the defeat of his troops. The command then devolved on Count O'Donnell; who, finding the greateſt part of his troops in diſorder, the night advanced, and the enemy poſſeſſed of ſome eminences which commanded his camp, and from which it was in vain to think of driving them, ordered a retreat, which was conducted with wonderful order and exactneſs; none were loſt in paſſing the bridges, and by far the greater part of their artillery was preſerved. The loſs of the Pruſſians was eſtimated at 10,000 killed and wounded, and 3000 taken priſoners. That of the Auſtrians in killed and wounded is not known; but 8000 were taken priſoners, with 216 officers, among whom were four generals.

62
All Saxony except Dreſden recovered.

The conſequence of the victory of Torgau was, that the king recovered all Saxony except Dreſden; and in the mean time General Werner having marched into Pomerania, the Ruſſians raiſed the ſiege of Colberg, and retired into Poland, without having effected any thing further than waſting the open country. Werner then flew to the aſſiſtance of Weſtern Pomerania, where he defeated a body of Swedes, and at laſt drove them totally out of the country. General Laudohn too abruptly raiſed the blockade of Coſel; and afterwards, abandoning Landſhut, he retired into the Auſtrian Sileſia, leaving the Pruſſian part entirely in quiet. M. Daun placed one part of his army in Dreſden, and the other in ſome ſtrong poſts which lie to the ſouth and weſt of it, by which he commanded the Elbe, and preſerved his communication with Bohemia. The army of the empire retired into Franconia, and placed its head-quarters at Bamberg.

Though theſe ſucceſſes had, to appearance, retrieved the king's affairs in ſome meaſure, yet his ſtrength ſeemed now to be wholly exhauſted; and in the campaign of 1761, he made no ſuch vigorous efforts as he had formerly done. The Ruſſians, dividing themſelves into two bodies, invaded Sileſia and Pomerania. In the former country they laid ſiege to Breſlau, and in the latter to Colberg. Tottleben alſo, who had commanded the Ruſſian armies, was now removed on a ſuſpicion that he had correſponded with the king of Pruſſia, and general Romanzow put in his place; by which it was expected that the Ruſſian operations would be more briſk this year than formerly.

The king continued ſtrongly encamped near Schweidnitz; where he was ſo cloſely watched by generals Daun and Laudohn, that he could attempt nothing. However, he defeated the deſigns of the Ruſſians againſt Breſlau, by ſending general Platen to deſtroy their magazines; which he accompliſhed with great ſucceſs, at the ſame time cutting off a body of 4000 of their troops. But this only brought the more ſure deſtruction upon Colberg; to which place the body of Ruſſians immediately marched, cruelly waſting the country as they went along. The king of Pruſſia could do nothing but ſend detachments of ſmall parties, which, though they could not oppoſe their enemies in the field, yet he hoped, by cutting off the convoys of the enemy, might diſtreſs them to ſuch a degree as to oblige them to abandon the ſiege, or at leaſt protract it till the ſeverity of the winter ſhould render it impoſſible for them to carry on their operations. Thus he weakened his own army ſo much, that it was found requiſite to draw 4000 men out of Schweidnitz in order to reinforce it; and no ſooner was this done, than general Laudohn ſuddenly attacked and took that fortreſs by a coup de main. Colberg made a brave defence; but the troops ſent to its relief being totally unable to cope with the Ruſſian army conſiſting of 50,000 men, it was obliged to ſurrender on the 3d of December; and thus the fate of the Pruſſian monarch ſeemed to be decided, and almoſt every part of his dominions lay open to the invaders.

63
Schweidnitz and Colberg retaken.

64
Empreſs of Ruſſia dies.

In the midſt of theſe gloomy appearances the empreſs of Ruſſia, the king's moſt inveterate and inflexible enemy, died on the 2d of January 1762. Her ſucceſſor, Peter III. inſtead of being the king's enemy, was his moſt ſanguine friend. As early as the 23d of February, in a memorial delivered to the miniſters of the allied courts, he declared, that, "in order to the eſtabliſhment of peace, he was ready to ſacrifice all the conqueſts made in this war by the arms of Ruſſia, in hopes that the allied courts will on their parts equally prefer the reſtoration of peace and tranquillity, to the advantages which they might expect from the continuance of the war, but which they cannot obtain but by a continuance of the effuſion of human blood."—This addreſs was not ſo well reliſhed by the allies: however, they were very willing to make peace, provided it was for their own intereſt; but they recommended to his attention fidelity to treaties, which conſtitutes a no leſs valuable part of the royal character, than humanity and diſintereſtedneſs. This anſwer made no impreſſion on the czar; a ſuſpenſion of hoſtilities took place on the 16th of March, which was followed by a treaty of alliance on the 5th of May. In this treaty the czar ſtipulated nothing in favour of his former confederates; on the contrary, he agreed to join his troops to thoſe of the king of Pruſſia, in order to act againſt them. Sweden, which had for a long time acted under the direction of Ruſſian counſels, now followed the example of her miſtreſs, and concluded a peace with Pruſſia on the 22d of May.

65
Peace between Ruſſia, Sweden, and Pruſſia.

66
Succeſſes of the king of Pruſſia.

It is not to be ſuppoſed that the king of Pruſſia would remain long inactive after ſuch an unexpected turn in his favour. His arms were now everywhere attended with ſucceſs. Prince Henry drove the Imperialiſts from ſome important poſts in Saxony, by which he ſecured all that part which the Pruſſians poſſeſſed; and though the Auſtrians frequently attempted to recover theſe poſts, they were conſtantly repulſed with great ſlaughter. The king was not joined by his new allies till the latter end of June; after which he drove M. Daun before him to the extremity of Sileſia, leaving the town of Schweidnitz entirely uncovered, and which the king immediately prepared to inveſt. In the mean time different detachments of Pruſſians, ſome on the ſide of Saxony, and others on that of Sileſia, penetrated deep into Bohemia, laid many parts of the country under contribution, and ſpread an univerſal alarm. A conſiderable body of Ruſſian irregulars alſo made an irruption into Bohemia, where they practiſed on the Auſtrians the ſame cruelties which they had long been accuſtomed to practiſe on the Pruſſians.

67
A new revolution in Ruſſia.

But while the king was thus making the beſt uſe of his time, he was all at once threatened with a fatal reverſe of fortune by a new revolution in Ruſſia. The emperor was depoſed, and his depoſition was ſoon after followed by his death. The empreſs, who ſucceeded him, ſuſpected that her huſband had been miſled by the counſels of his Pruſſian majeſty, againſt whom, therefore, ſhe entertained a mortal enmity. She could not, however, in the very beginning of her reign, undertake again a war of ſo much importance as that which had been juſt concluded. She therefore declared her intention of obſerving the peace concluded by the late emperor; but, at the ſame time, of recalling her armies from Sileſia, Pruſſia, and Pomerania; which indeed the unſettled ſtate of the kingdom now made in ſome degree neceſſary. At the ſame time a diſcovery was made with regard to the king of Pruſſia himſelf, which turned the ſcale greatly in his favour. The Ruſſian ſenate, flaming with reſentment againſt this monarch, and againſt their late unfortunate ſovereign; and the empreſs, full of ſuſpicion that the conduct of the latter might have been influenced by the councils of the former, ſearched eagerly amongſt the papers of the late emperor for an elucidation or proofs of this point. They found indeed many letters from the Pruſſian monarch; but in a ſtrain abſolutely different from what they had expected. The king had, as far as prudence would permit, kept a reſerve and diſtance with regard to the too raſh advances of this unhappy ally; and, in particular, counſelled him to undertake nothing againſt the empreſs his conſort. The hearing of theſe letters read is ſaid to have had ſuch an effect upon the empreſs, that ſhe burſt into tears, and expreſſed her gratitude towards the Pruſſian monarch in the warmeſt terms. Still, however, the Ruſſian army was ordered to ſeparate from the Pruſſians; but all the important places which the former had taken during the whole war were faithfully reſtored.

68
General Laudohn utterly defeated.

The king, finding that the Ruſſians were no more to take an active part in his favour, reſolved to profit by their appearance in his camp; and therefore, the very day after the order for their return had arrived, he attacked the Auſtrian army, and drove their right wing from ſome eminences and villages where they were advantageouſly poſted; by which means he entirely cut off their communication with Schweidnitz, ſo that nothing could be attempted for its relief. Prince Henry kept them in continual alarms for Bohemia; and a great part of their attention, and no ſmall part of their forces, were engaged on that ſide. Marſhal Daun, now finding himſelf rendered almoſt incapable of undertaking any thing, detached general Laudohn, with a force very much ſuperior, to attack the prince of Bevern, and drive him from the advantageous poſt he occupied. But the prince defended himſelf with ſuch reſolution, that all the efforts of Laudohn could not ſucceed before the king had time to come to his aſſiſtance. The Auſtrians, being then put between two fires, were routed and purſued with terrible ſlaughter; after which, the king met with no more diſturbance in his preparations for the ſiege, and the trenches were opened on the 18th of July. Marſhal Daun made no attempts to relieve the place; but the garriſon being very ſtrong, it held out for near two months from the opening of the trenches. It is ſaid that the attack was conducted, and the defence made, by two engineers who had written on the ſubject of the attack and defence of fortified places; and they were now practically engaged to prove the ſuperiority of their ſyſtems. At laſt, however, the garriſon, to the number of 8000 men, ſurrendered priſoners of war; and the whole body, except nine, were ſoon after drowned at the mouth of the Oder, on their paſſage to their intended confinement at Konigſberg.

69
The total defeat of the Auſtrians at Freyberg produces a peace.

The king of Pruſſia, now become maſter of Schweidnitz, turned his attention towards Saxony, where he conſiderably reinforced his brother's army, and made preparations for laying ſiege to Dreſden. In this country the Auſtrians had lately met with ſome ſucceſs, and driven Prince Henry back as far as Freyberg; but on the 29th of October, they were attacked by the Pruſſian army thus reinforced, and totally routed. Great numbers were ſlain, and near 6000 taken priſoners. This victory proved deciſive: and the empreſs-queen, finding herſelf deſerted by all her allies, was glad to conclude a treaty; the ſubſtance of which was, that a mutual reſtitution and oblivion ſhould take place, and both parties ſit down at the end of the war in the ſame ſituation in which they began it. This treaty is called the *peace of Hubertſburg*.

The war was no ſooner concluded than the king of Pruſſia turned his attention to domeſtic policy, and the recovery of his dominions from thoſe innumerable calamities which had befallen them during the war. He immediately diſtributed lands to his diſbanded ſoldiers, and gave them the horſes of his artillery to aſſiſt them in their cultivation. By his wiſe and prudent management, the horrors of war were ſoon forgot; and the country was quickly in as flouriſhing a ſtate as ever. Notwithſtanding this pacific diſpoſition, however, the king never ſlackened his endeavours for the defence of his country, by keeping a reſpectable army on foot; which might be able to act on the leaſt emergency.

70
A new war commences, but produces no memorable event.

In the year 1778, a new difference with the houſe of Auſtria took place, concerning the duchy of Bavaria. But though the moſt enormous warlike preparations were made on both ſides, and immenſe armies brought into the field, nothing of conſequence was effected. What little advantage there was, ſeems to have been on the Pruſſian ſide, ſince they made themſelves maſters of ſeveral towns, and kept the war in the enemy's country. However, the emperor acted with ſo much caution and ſhowed ſo much ſkill in a defenſive war, that all the manœuvres of his Pruſſian majeſty could gain no material advantage; as, on the other hand, his adverſary was too wiſe to venture an engagement. A peace therefore was very ſoon concluded, and ſince that time the hiſtory of Pruſſia, during the remainder of the great Frederic's reign, affords no remarkable event which we have not mentioned in the life of that hero, and in the article **POLAND**. He left his crown to his nephew, whoſe character was not then much developed; and it was eaſily ſeen that a new kingdom, which had riſen ſuddenly to ſuch unexampled power and greatneſs as to excite the jealouſy or apprehenſion of all its neighbours, would require great abilities to preſerve it from diſmemberment.

71
The great Frederic ſucceeded by his nephew.

72
State of the nation, and behaviour of the new king.

The late king had indeed bequeathed the moſt effectual ſecurities to his ſucceſſor for the preſervation of his dominions, that human wiſdom could provide or deviſe; by leaving him a full treaſury, the fineſt army in the world, and a people enthuſiaſtically attached to his memory and government. The new monarch, with theſe advantages, was not wanting to himſelf. The late king's predilection for the French language and French literature were not grateful to his ſubjects. The preſent ſovereign began his reign with declaring in council, "Germans we are, and Germans I mean we ſhall continue;" giving directions at the ſame time, that their native language ſhould reſume its natural rank and ſtation, from which for near half a century it had been degraded by the French. This was a very popular meaſure, and it was followed by another ſtill more ſo. Obſerving that he had marked with great concern the progreſs of impiety and profaneneſs on the one hand, and of enthuſiaſm on the other, he declared, that he would not have his ſubjects corrupted either by fanatics or atheiſts, and ſtrictly prohibited all publications tending to excite a contempt or indifference for religion.

73
He aſſiſts the ſtadtholder againſt the ſtates of Holland.

Such, on his immediate acceſſion to the throne, was the pacific conduct of the monarch, which endeared him to his ſubjects, and commanded the approbation of all good men. An opportunity ſoon occurred, in which he was thought to have diſplayed ſuch talents in negotiation and in military arrangements, as proclaimed him in every reſpect a worthy ſucceſſor of his uncle. The States of Holland, who had long been jealous of the power of the Stadtholder, and inclined to a republican government without any permanent chief, had gained ed ſuch an aſcendency in the ſtates general, that in 1786 and 1787 they in effect diveſted the prince of Orange of all his prerogatives (ſee *United Provinces*.) They proceeded even to the ſeizure and impriſonment of the princeſs, ſiſter to the king of Pruſſia; and depending upon ſupport from France, treated with inſolence every power connected with them in Europe. The court of Berlin did not witneſs theſe proceedings without indignation; and the king formed his plan for reſtoring the power of the Stadtholder with ſuch ſecrecy and prudence, that perhaps nothing could ſurpaſs it but the bravery and military ſkill of the duke of Brunſwick, by whom it was carried into execution. In the ſhort ſpace of one month, that accompliſhed general led 18,000 Pruſſians to Amſterdam, and reſtored the prerogatives of the prince of Orange. And here, we believe, the friends of the houſe of Brandenburg will agree with us, that our hiſtory of Pruſſia ſhould conclude. The monarch's ſubſequent conduct has not been ſuch as the beginning of his reign gave reaſon to expect. Something of it will be ſeen under the article Poland, and more under Revolution and *United Provinces*; and it is not a ſubject upon which we delight to dwell.

74
Air, ſoil, and population, of Pruſſia.

The air of Pruſſia is wholeſome, and the ſoil fruitful in grain; affording, beſides, plenty of pitcoal and other fuel. The rivers and lakes are well ſtored with fiſh; and amber is found on its coaſt towards the Baltic. The principal rivers are the Viſtula, Bregel, Memel, the Paſſarge, and the Elbe; all of which frequently do damage by their inundations.

The inhabitants of this country were, by Dr Buſching, computed at 635,998 perſons capable of bearing arms; and by another German author, at 450,000. Since the year 1719 it is computed that about 34,000 coloniſts have removed hither from France, Switzerland, and Germany; of which number one half were Saltzburgers. Theſe emigrants have built 400 ſmall villages, 11 towns, 50 new churches, and founded 1000 village-ſchools. The manners of the people differ but little from thoſe of the Germans. The eſtabliſhed religions are thoſe of Luther and Calvin, but chiefly the former; though almoſt all other ſects are tolerated.

75
Commerce and manufactures.

The late king of Pruſſia, by the aſſiſtance of an excellent police, brought the commerce and manufactures of this country to a very flouriſhing ſtate, which during his life were daily improving. The manufactures of Pruſſia conſiſt in glaſs, iron-work, paper, gunpowder, copper, and braſs-mills; manufactures of cloth, camblet, linen, ſilk, gold and ſilver lace, ſtockings, and other articles. The inhabitants export variety of naval ſtores; amber, lint-ſeed and hemp-ſeed, oat-meal, fiſh, mead, tallow, and caviar; and it is ſaid that 500 ſhips are loaded with thoſe commodities every year, chiefly from Koningſberg.

76
Conſtitution.

His Pruſſian majeſty is abſolute through all his dominions; but the late king was too wiſe to oppreſs his ſubjects, though he availed himſelf to the full of his power. How the preſent ſovereign treats them we know not, as the whole of his conduct for ſome time paſt has related to the Poliſh and French revolutions. The government of this kingdom is by a regency of four chancellors of ſtate, *viz.* 1. The great-maſter; 2. The great-burgave; 3. The great-chancellor; and, 4. The great-marſhal. There are alſo ſome other councils, and 37 bailiwicks. The ſtate conſiſts, 1. Of counſellors of ſtate; 2. Of deputies from the nobility; and, 3. From the commons. Beſides theſe inſtitutions, the late king erected a board for commerce and navigation.

77
Revenues.

His Pruſſian majeſty, by means of the happy ſituation of his country, its inland navigation, and the excellent regulations of his predeceſſor, derives an amazing revenue from this country, which, about a century and a half ago, was the ſeat of boors and barbariſm. It is ſaid, that amber alone brings him in 26,000 dollars annually. His other revenues ariſe from his demeſnes, his duties of cuſtoms and tolls, and the ſubſidies yearly granted by the ſeveral ſtates; but the exact ſum is not known, though we may conclude that it is very conſiderable, from the immenſe charges of the late war.

78
Military ſtrength.

The military regulations introduced by the late king had a wonderfully quick operation in forming his troops and recruiting his armies. Every regiment has a particular diſtrict aſſigned it, where the young men proper for bearing arms are regiſtered; and when occaſion offers, they join their regiment, and being incorporated with veterans they ſoon become well diſciplined troops. The Pruſſian army, in time of peace, conſiſts of 175,000 of the beſt diſciplined troops in the world; and during the laſt war, that force was augmented to 300,000 men.

79
Royal arms, &c.

The royal arms of Pruſſia are argent, an eagle diſplayed ſable, crowned, or, for Pruſſia: azure, the Imperial ſceptre, or, for Courland: argent, an eagle diſplayed, gules, with ſemicircular wreaths, for the marquiſate of Brandenburg: to theſe are added the reſpective arms of the ſeveral provinces ſubject to the Pruſſian crown.

There are two orders of knighthood; the firſt, that of the Black Eagle, inſtituted by Frederic I. on the day of his coronation at Koningſberg, with this motto, *Suum cuique*. The ſovereign is always grand-maſter; and the number of knights, excluſive of the royal family, is limited to 30. Next to this is the order of Merit, inſtituted by his late majeſty; the motto is, *Pour le merite*.

PRUSSIAN blue. See Chemistry-*Index*, at *Colouring Matter* and *Pruſſian Blue*.

Chemical Annals, vol. i. p. 19, &c.

PRUSSIC acid, according to M. Berthollet, is a combination of azot of hydrogene and carbon. It appears much leſs akin to acids than to ammoniac; it has, however, too many properties in common with other acids not to place it in the ſame claſs, the rather becauſe our claſſifications are always in a degree arbitrary, and ought to be conſidered rather as uſeful methods, than as diviſions formed by nature. When the Pruſſic acid is combined with alkali and oxyd of iron, it cannot be ſeparated by any other acid, unleſs heat be employed, or it be expoſed to light; and nevertheleſs, when it is diſengaged by one of theſe means, it cannot ſeparate iron, even from the weakeſt acid, unleſs it be by a double affinity. It appears that this property is connected with the elaſtic ſtate, which is unfavourable to theſe combinations: it muſt have loſt this ſtate, in other words its ſpecific heat muſt be diminiſhed, in order that it may poſſeſs its affinities with metallic oxyds and alkalis. Nitrous gas, oxygenated muriatic acid, and ſulphureous acid, preſent analogous phenomena.

PRYNNE (William), an Engliſh lawyer, much

Prynne
‖
Pſalmanazar.

diſtinguiſhed in the civil commotions under Charles I. was born at Swainſwick in Somerſetſhire in 1600. His *Hiſtriomaſtix*, written againſt ſtage-plays in 1632, containing ſome reflections that offended the court, he was ſentenced by the ſtar-chamber to pay a fine of 5000 l. to ſtand in the pillory, to loſe his ears, and to perpetual impriſonment. During his confinement, he wrote ſeveral more books; particularly, in 1637, one entitled *News from Ipſwich*, which reflecting ſeverely on the biſhops, he was again ſentenced by the ſtar-chamber to another fine of 5000 l. to loſe the remainder of his ears in the pillory, to be branded on both cheeks with S. L. for ſeditious libeller, and to be perpetually impriſoned in Caernarvon caſtle. Nothing but cutting off his hands could have prevented Prynne from writing: he wrote ſtill; and in 1640, being ſet at liberty by the houſe of commons, he entered London in a kind of triumph, was elected into parliament for Newport in Cornwall, and oppoſed the biſhops with great vigour, being the chief manager of archbiſhop Laud's trial. In the long parliament he was zealous in the Preſbyterian cauſe; but when the Independents gained the aſcendency, he oppoſed them warmly, and promoted an agreement with the king. When the army garbled the houſe and refuſed him entrance, he became a bitter enemy to them and their leader Cromwell, and attacked them with his pen ſo ſeverely, that he was again impriſoned: but he pleaded the liberty of the ſubject ſo ſucceſsfully, that he was enlarged, to write more controverſial books. Being reſtored to his ſeat after Cromwell's death, with the other ſecluded members, he aſſiſted in promoting the reſtoration, and was appointed keeper of the Tower records; a place excellently well calculated for him, and where he was very uſeful by the collections he publiſhed from them. He preſented 40 volumes of his works, in folio and 4to, to Lincoln's-inn library, of which ſociety he was a member; and, dying in 1669, was buried under the chapel.

PRYTANES, in Grecian antiquity, were the preſidents of the ſenate, whoſe authority conſiſted chiefly in aſſembling the ſenate; which, for the moſt part, was done once every day.

The ſenate conſiſted of 500, 50 ſenators being elected out of each tribe: after which, lots were caſt, to determine in what order the ſenators of each tribe ſhould preſide; which they did by turns, and during their preſidentſhip were called *prytanes*. However, all the 50 prytanes of the tribes did not govern at once, but one at a time, viz. for ſeven days; and after 35 days, another tribe came into play, and preſided for other five weeks; and ſo of the reſt.

PSALM, a divine ſong or hymn; but chiefly appropriated to the 150 Pſalms of David, a canonical book of the Old Teſtament.

Moſt of the pſalms have a particular title, ſignifying either the name of the author, the perſon who was to ſet it to muſic or ſing it, the inſtrument that was to be uſed, or the ſubject and occaſion of it. Some have imagined that David was the ſole author of the Book of Pſalms; but the titles of many of them prove the contrary, as pſalm cx. which appears to have been written by Moſes. Many of the pſalms are inſcribed with the names *Korah*, *Jeduthun*, &c. from the perſons who were to ſing them.

Pſalmanazar.

PSALMANAZAR (George), the fictitious name of a pretended Formoſan, a perſon of learning and ingenuity. He was born in France, and educated in a free-ſchool, and afterwards in a college of Jeſuits, in an archiepiſcopal city, the name of which, as likewiſe thoſe of his birth-place and of his parents, are unknown. Upon leaving the college, he was recommended as a tutor to a young gentleman; but ſoon fell into a mean rambling life, that involved him in diſappointments and misfortunes. His firſt pretence was that of being a ſufferer for religion. He procured a certificate that he was of Iriſh extraction, that he left that country for the ſake of the Catholic faith, and was going on a pilgrimage to Rome. Being unable to purchaſe a pilgrim's garb, and obſerving one in a chapel, dedicated to a miraculous ſaint, which had been ſet up as a monument of gratitude by ſome wandering pilgrim, he contrived to take both the ſtaff and cloak away; and, being thus accoutred, begged his way in fluent Latin, accoſting only clergymen or perſons of figure; whom he found ſo generous and credulous, that, before he had gone 20 miles, he might eaſily have ſaved money, and put himſelf in a much better dreſs: but as ſoon as he had got what he thought was ſufficient, he begged no more; but viewed every thing worth ſeeing, and then retired to ſome inn, where he ſpent his money as freely as he had obtained it. Having heard the Jeſuits ſpeak much of China and Japan, he ſtarted the wild ſcheme, when he was in Germany, of paſſing for a native of the iſland of Formoſa; and what he wanted in knowledge, he ſupplied by a pregnant invention. He formed a new character and language on grammatical principles, which, like other oriental languages, he wrote from right to left with great readineſs; and planned a new religion, and a diviſion of the year into 20 months, with other novelties, to credit his pretenſions. He was now a Japaneſe convert to Chriſtianity, travelling for inſtruction, with an appearance more wretched than even that of common beggars. He then entered as a ſoldier in the Dutch ſervice: but, ſtill deſirous of paſſing for a Japaneſe, he altered his plan to that of being an unconverted heathen; and at Sluys, brigadier Lauder, a Scots colonel, introduced him to the chaplain, who, with a view of recommending himſelf to the biſhop of London, reſolved to carry him over to England. At Rotterdam, ſome perſons having put ſhrewd queſtions to him, that carried the air of doubt, he took one more whimſical ſtep, which was to live upon raw fleſh, roots, and herbs; which ſtrange food he thought would remove all ſcruples. The biſhop of London patronized him with credulous humanity; and Pſalmanazar found a large circle of friends, who extolled him as a prodigy. Yet were there ſome who entertained a juſt opinion of him, particularly the Drs Daliey, Mead, and Woodward; but their endeavours to expoſe him as a cheat only made others think the better of him, eſpecially as thoſe gentlemen were eſteemed no great admirers of revelation. But in this inſtance at leaſt, eaſineſs of belief was no great evidence of penetration. He was employed to tranſlate the church-catechiſm into the Formoſan language, which was examined, approved, and laid up as a valuable MS; and the author, after writing his well-known *Hiſtory of Formoſa*, was rewarded and ſent to Oxford to ſtudy what he liked, while his patrons and opponents were learnedly diſputing at Lon[illegible] on the merits of his work. The learned members of the univerſity were no better agreed in their opinions than thoſe at London; but at length the ſceptics triumphed. Some abſurdities were diſcovered in his hiſtory, of ſuch a nature as to diſcredit the whole narration, and ſaved him the trouble of an open declaration of his impoſture; which however he owned at length to his private friends. For the remainder of his life, his learning and ingenuity enabled him to procure a comfortable ſupport by his pen; he being concerned in ſeveral works of credit, particularly *The Univerſal Hiſtory*. He lived irreproachably for many years, and died in 1763.

PSALMIST, in the church of Rome, one of the leſſer eccleſiaſtical orders; the ſame with what among us is called *clerk*, *precentor*, or *ſinger*.

PSALMODY, the art or act of ſinging pſalms. See Psalm.

Pſalmody was always eſteemed a conſiderable part of devotion, and uſually performed in the ſtanding poſture: and as to the manner of pronunciation, the plain ſong was ſometimes uſed, being a gentle inflection of the voice, not much different from reading, like the chant in cathedrals; at other times more artificial compoſitions were uſed, like our anthems.

As to the perſons concerned in ſinging, ſometimes a ſingle perſon ſung alone; ſometimes the whole aſſembly joined together, which was the moſt ancient and general practice. At other times, the pſalms were ſung alternately, the congregation dividing themſelves into two parts, and ſinging verſe about, in their turns. There was alſo a fourth way of ſinging, pretty common in the fourth century, which was, when a ſingle perſon began the verſe, and the people joined with him in the cloſe: this was often uſed for variety, in the ſame ſervice with alternate pſalmody.

The uſe of muſical inſtruments, in the ſinging of pſalms, ſeems to be as ancient as pſalmody itſelf; the firſt pſalm we read of being ſung to the timbrel, viz. that of Moſes and Miriam, after the deliverance of the Iſraelites from Egypt: and afterwards, muſical inſtruments were in conſtant uſe in the temple of Jeruſalem. See Organ.

PSALTER, the ſame with the book of pſalms. See the article Psalm.

Among the religious in the Popiſh countries, the term *pſalter* is alſo given to a large chaplet or roſary, conſiſting of 150 beads, according to the number of pſalms in the pſalter.

PSALTERY, a muſical inſtrument, much in uſe among the ancient Hebrews, who called it *nebel*.

We know little or nothing of the preciſe form of the ancient pſaltery. That now in uſe is a flat inſtrument, in form of a trapezium or triangle truncated at top: it is ſtrung with 13 wire-chords, ſet to uniſon or octave, and mounted on two bridges, on the two ſides: it is ſtruck with a plectrum, or little iron rod, and ſometimes with a crooked ſtick. Its cheſt or body reſembles that of a ſpinet. See Nablum and Plate CCCXLIV.

PSAMMETICUS, or Psammitichus, a renowned conqueror, who, ſubduing 11 other petty kings of Egypt, became the founder of the kingdom of Egypt, about 670 B. C. He is memorable likewiſe for taking the city of Azot, after a ſiege of 29 years; and for diſcovering the ſources of the river Nile. See Egypt, nº 10.

PSATYRIANS, a ſect of Arians, who, in the council of Antioch, held in the year 360, maintained that the Son was not like the Father as to will; that he was taken from nothing, or made of nothing; and that in God, generation was not to be diſtinguiſhed from creation.

Enfield's Hiſtory of Philoſophy.

PSELLUS (Michael), a learned Chriſtian of the 11th century, was, by birth, a Conſtantinopolitan of conſular rank, and flouriſhed under the emperor Conſtantine Monomachus. His genius and induſtry raiſed him far above the level of his cotemporaries; and the female hiſtorian Anna Comnena ſpeaks of him as one who had been more indebted for his attainments to his own excellent talent than to the inſtructions of his preceptors; adding, that having made himſelf maſter of all the wiſdom of the Greeks and the Chaldeans, he was juſtly eſteemed the moſt learned man of the age. Thus furniſhed, he became the chief inſtructor of the Conſtantinopolitan youth. He was at the ſame time the companion and the preceptor of the emperor, who was ſo captivated by the ſtudies and amuſements in which Pſellus engaged him, that, according to Zonaras, he neglected the concerns of the empire. The Byzantine hiſtorians complain, that the emperor, deluded by the head of the philoſophers (the title with which Pſellus was honoured), loſt the world. Meeting, towards the cloſe of his life, with ſome diſappointment, Pſellus retired into a monaſtery, and ſoon afterwards died; the time of his death is uncertain. His works, which have been much celebrated, are, Commentaries upon Ariſtotle's Logic and Phyſics; a Compendium of Queſtions and Anſwers; and an Explanation of the Chaldean Oracles. The two latter works prove him to have been converſant, not only with Grecian, but with Oriental, philoſophy.

PSEUDO, from ψευδος, a Greek term uſed in the compoſition of many words, to denote *falſe* or *ſpurious*: as the pſeudo-acacia, or baſtard acacia; pſeudo-fumaria, or baſtard-fumitory; pſeudo-ruta, or baſtard-rue, &c.

We alſo ſay, a pſeudo-apoſtle, or falſe apoſtle; a pſeudo-prophet, or falſe prophet, &c.

Pseudo-China. See Smilax.

Pseudo-Galena, or *Black Jack*. See Zinc, and Mineralogy, p. 62.

Pseudo-Tinea, in natural hiſtory, the name of a very remarkable ſpecies of inſect deſcribed by M. Reaumur, approaching to the nature of the *tinea*, or *clothes-moth* while in the worm-ſtate, but not making themſelves coats of the ſubſtance of leaves, cloth, &c. though they form a ſort of caſes for their defence againſt a very terrible enemy.

Theſe creatures are of the caterpillar kind, and have, in the manner of many of theſe inſects, 16 legs. They feed on wax, and for food enter the bee-hives; where they boldly engage the bees, and are not to be prevented by them from feeding, though at the expence of their habitations and the cells of their reſervoirs of honey: ſo that it is no uncommon thing for a ſwarm of bees to be forced to change their place of habitation, and make new combs elſewhere; leaving the old ones to this contemptible victor, whom they know not how to drive out or diſpoſſeſs.

Virgil and Ariſtotle, and all the authors who have written on bees, have complained of this deſtructive animal. It never eats the honey, but feeds only on the wax; attacking principally thoſe waxy cells where the female bee depoſites her eggs for the future progeny.

The bees, who are a match for moſt other creatures by means of their ſtings, would eaſily deſtroy theſe weak creatures, were it not for the impervious armour they are covered with. They form themſelves a coat of armour of a double matter. The firſt, which immediately covers the body, is of a kind of ſilk of their own ſpinning; and the outer covering over this is of the bees-wax: this is laid conſiderably thick; and the creature, juſt thruſting out its head to feed, goes on devouring the cells undiſturbed, while a whole army of the inhabitants are in vain buzzing about him, and attempting to pierce him with their ſtings. He never forſakes his covering, but lengthens and enlarges it as he goes; and gnawing down the ſides of the cells in his march, without ſtaying to eat them one by one, the havock and deſtruction he occaſions are ſcarce to be conceived. When the time of the change of this creature approaches, it contracts its body within its double covering, and there changes into the nymph ſtate; whence, after a proper time, it comes forth in form of a moth, with granulated horns and a crooked proboſcis.

The bees have cunning enough to know their deſtructive enemy in this new form; and as this is a weak and defenceleſs ſtate, they attack and deſtroy all the moths of this ſpecies they can meet with. They ſeldom are ſo fortunate, however, as to kill the whole race as ſoon as produced; and if only one eſcapes, it is able to lay a foundation of revenge for the death of its brethren. All the flies of the moth kind lay a vaſt number of eggs, and this is behind hand with none of them in that particular: the young ones produced from the eggs of one ſurviving female of this ſpecies are ſufficient to deſtroy many honey-combs; nay, many hives of them. The moth produced by this caterpillar flies but little; yet it is very nimble in avoiding danger, by running, which it does with great ſwiftneſs.

There is a ſpecies of theſe pſeudo-tineæ, or wax-eating caterpillars, which infeſt the ſubterraneous hives of waſps and other creatures which make wax: the manner of living, feeding, and defending themſelves from their enemies, is the ſame in all the ſpecies. Theſe laſt, if they are at any time diſtreſſed for food, will eat their own dung; the wax having paſſed almoſt unaltered through their bodies, and being ſtill wax, and capable of affording them more nouriſhment on a ſecond digeſtion. Theſe ſpecies, though they naturally live on this ſoft food, yet if by any accident they meet with harder only, they know how to live upon it; and can eat a way into the covers and leaves of books, and make themſelves caſes and coverings of the fragments of theſe ſubſtances. The accurate author [†] of theſe obſervations deſcribes alſo a kind of *pſeudo-tinea* which feeds on wool, and another that eats leather; both making themſelves houſes alſo of the materials they feed on.

There is alſo another kind very deſtructive to corn: theſe make themſelves a covering by faſtening together a great number of the grains, and there living and eating in ſecret. All theſe creatures, whatever be their food or habitation, finally become *phalenæ*, or moths; and may be diſtinguiſhed, even in this ſtate, from the other ſpecies, by having granulated horns of a remarkable ſtructure, and all of them a proboſcis, or trunk, more or leſs incurvated.

PSEUDONYMUS, among critics, an author who publiſhes a book under a falſe or feigned name; as *cryptonymus* is given to him who publiſhes one under a diſguiſed name, and *anonymous* to him who publiſhes without any name at all.

PSIDIUM, the GUAVA: A genus of the monogynia order, belonging to the icoſandria claſs of plants; and in the natural method ranking under the 19th order, *Heſperideæ*. The calyx is quinquefid, ſuperior; there are five petals; the berry is unilocular and monoſpermous. There are two ſpecies: 1. The pyriferum, or white guava; 2. The pomiferum, or red guava. Both theſe are thought to be only varieties of the ſame plant. The red guava riſes to the height of 20 feet, and is covered with a ſmooth bark; the branches are angular, covered with oval leaves, having a ſtrong midrib, and many veins running towards the ſides, of a light green colour, ſtanding oppoſite upon very ſhort footſtalks. From the wings of the leaves the flowers come out upon footſtalks an inch and an half long: they are compoſed of five large roundiſh concave petals, within which are a great number of ſtamina ſhorter than the petals, and tipped with pale yellow tops. After the flower is paſt, the germen becomes a large oval fruit ſhaped like a pomegranate.

A decoction of the roots of guava is employed with ſucceſs in dyſenteries: a bath of a decoction of the leaves is ſaid to cure the itch and other cutaneous eruptions. Guayava, or guava, is diſtinguiſhed from the colour of the pulp, into the two ſpecies abovementioned, the white and the red; and, from the figure of the fruit, into the round, and the pear-faſhioned or perfumed guava. The latter has a thicker rind, and a more delicate taſte than the other. The fruit is about the bigneſs of a large tennis-ball; the rind or ſkin generally of a ruſſet ſtained with red. The pulp within the thick rind is of an agreeable flavour, and interſperſed with a number of ſmall white ſeeds. The rind, when ſtewed, is eaten with milk, and preferred to any other ſtewed fruit. From the ſame part is made marmalade; and from the whole fruit is prepared the fineſt jelly in the world. The fruit is very aſtringent, and nearly of the ſame quality with the pomegranate; ſo ſhould be avoided by all who are ſubject to coſtiveneſs. The ſeeds are ſo hard as not to be affected by the fermentation in the ſtomachs of animals; ſo that when voided with the excrements, they take root, germinate, and produce thriving trees. Whole meadows in the Weſt Indies are covered with guavas, which have been propagated in this manner. The buds of guava, boiled with barley and liquorice, produce an excellent ptiſan for diarrhœas, and even the bloody flux, when not too inveterate. The wood of the tree, employed as fuel, makes a lively, ardent, and laſting fire.

PSITTACUS, or PARROT, in ornithology; a genus belonging to the order of *picæ*. The bill in this genus is hooked from the baſe; and the upper mandible is moveable: the noſtrils are round, placed in the baſe of the bill, which in ſome ſpecies is furniſhed with a kind of cere: the tongue is broad, and blunt at one end: the head is large, and the crown flat: the legs are ſhort, the toes placed two before and two behind. It might ſeem a wonder why nature has deſtined to this, which is not naturally a bird of prey, but feeds on fruits and vegetable ſubſtances, the crooked beak allotted to the hawk and other carnivorous birds: but the reaſon ſeems to be, that the parrot being a heavy bird, and its legs not very fit for ſervice, it climbs up and down trees by the help of this ſharp and hooked bill, with which it lays hold of any thing and ſecures itſelf before it ſtirs a foot; and beſides this, it helps itſelf forward very much, by pulling its body on with this hold.

[†] Reaumur's Hiſtory of Inſects.

Of all animals, the parrot and crocodile are the only ones which move the upper jaw; all creatures elſe moving the lower only. As ſome particular animals beſide are fond of particular foods, ſo the parrot loves nothing ſo much as the ſeeds of the carthamas, or baſtard ſaffron; and eats them without any hurt, though they are a purge when given to other creatures.

Parrots are found almoſt every-where within the tropics; and in their natural ſtate they live on fruits and ſeeds, though, when tame, they will eat fleſh, and even fiſh.

In the Eaſt and Weſt Indies they are very common, and in ſuch warm climates are very briſk and lively; here, however, they loſe much of their vigour. They ſeldom make neſts, but breed like owls in hollow trees; they lay two eggs. At particular times they fly in very large troops, but ſtill they keep two and two together. This genus conſiſts of infinite variety, not ſo much owing to mixture of ſpecies, however, as might be ſuppoſed. They ſeem to run vaſtly into one another, ſo as to appear to be related, though received from different parts of the world; this, however, may poſſibly be occaſioned by their being carried from one place to another for the ſake of ſale. This uncertainty of native place has prevented Mr Latham from following Buffon's plan, and ranging them according to the places they are ſuppoſed to inhabit; he divides them therefore into thoſe with *uneven* and thoſe with *even* tails.

Buffon ranges the parrots in two great claſſes: the firſt of which comprehends thoſe of the Old Continent, and the ſecond thoſe of the New. The former he ſubdivides into five families, the Cockatoos, the Parrots, properly ſo called, the Lories, the long-tailed Paroquets, and the ſhort-tailed ones; and the latter into ſix, viz. the Macaos, the Amazonians, the Creeks, the Popinjays, the long-tailed Paroquets, and the ſhort-tailed ones.

Mr Latham has increaſed the genus from 47 to 163; and ſince the time he wrote his *Index* at leaſt 20 more have been diſcovered. They are very generally divided into three kinds: 1. The larger, which are as big as a moderate fowl, called *macaos* and *cocketoons*; theſe have very long tails. 2. The middle-ſized ones, commonly called *parrots*, which have ſhort tails, and are a little larger than a pigeon. And, 3. The ſmall ones, which are called *paroquets*, and have long tails, and are not larger than a lark or blackbird.

1. The pſittacus macao, or red and blue macao, is red, except the wing quills, which above are blue, below rufous: the ſcapular feathers are variegated with blue and green: the cheeks are naked and wrinkled. It is about two feet ſeven inches and a half long, and about as big as a capon. Edwards ſays, when perfect, it will meaſure a full yard from bill to tail. It inhabits Braſil, Guiana, and other parts of South America. It was formerly very common in St Domingo, but is now rarely found there. It generally lives in moiſt woods, eſpecially ſuch as are planted with a particular kind of palm, perhaps what is called the *macaw* tree. It does not in general learn to ſpeak, and its voice is particularly rough and diſagreeable. The fleſh is hard, black, and unſavoury, but makes good ſoup, and is much uſed by the inhabitants of Cayenne and other places. This ſpecies, in common with other parrots, is ſubject to fits when tamed; and though it will live for many years though the returns be pretty frequent, it generally falls a victim to that diſeaſe at laſt. The Americans call it *gonzalo*. 2. The pſittacus ararauna, or blue and yellow macaw, is blue above, and yellow below, and the cheeks are naked, with feathery lines. It is about the ſame ſize with the laſt, and inhabits Jamaica, Guiana, Braſil, and Surinam. 3. The pſittacus ſeverus, or Braſilian green macaw, is black, with a greeniſh ſplendor; the bill and eyes are reddiſh, and the legs are yellow. It is about one foot and five inches long, and is common in Jamaica, Guiana, and Braſil. It is however comparatively rare; but it is extremely beautiful, and of a very amiable and ſociable temper when familiar and acquainted; but it can neither bear ſtrangers nor rivals: its voice it not ſtrong, nor does it articulate very diſtinctly the word *ara*. See Plate CCCCXVI.

4. The pſittacus aurora, or yellow amazon, is about 12 inches long, of a green colour, with blue wing quills, and a white front; its orbits are ſnowy. It inhabits Mexico or Braſil; but in all probability the latter, from the one which Salerne ſaw, and which pronounced Portugueſe words. The pſittacus guineenſis, or yellew lory, is about ten inches long, and is an inhabitant of Guinea. The bill is of a black colour; the cere, the throat, and ſpace about the eyes, are white; above the eye there is a patch of yellow, and the reſt of the head and neck is crimſon. The breaſt is yellow, wing coverts green, and the quills are blue, edged with yellow. Under the wings, belly, thighs, vent, and to the under part of the tail, the colour is white, which laſt is tipped with red; the legs are duſky, and the claws black. See Plate CCCCXVI.

5. The pſittacus pullarius, red-headed Guinea parraket, or Guinea ſparrow, is about five inches and a half long. It inhabits Guinea, and is found in Ethiopia, the Eaſt Indies, and the iſland of Java, and ſometimes in Surinam. It is green, with a red front, fulvous tail, black bar, and cinereous orbits. The male of this ſpecies is peculiarly affectionate to the female. See Plate CCCCXVI.

In Mr White's *Journal of a Voyage to New South Wales*, we find a deſcription, with excellent engravings, of ſeveral ſpecies of this extenſive genus; and in Governor Philip's Voyage to the ſame place, we find deſcriptions and prints of ſeveral of the ſame ſpecies. But the moſt particular of the later authors are Buffon and Latham, eſpecially the laſt; to whoſe extenſive and accurate work we therefore refer our readers for that information which our limits permit us not to give. See his *Synopſis*, vol. i. p. 194—323. See alſo *Buffon*, vol. vi. p. 63—245.

PSOAS, in anatomy. See there, *Table of the Muſcles*.

PSOPHIA, in ornithology; a genus belonging to the order *gallinæ*. The bill is moderate; the upper mandible is convex; the noſtrils are oblong, ſunk, and pervious; the tongue is cartilaginous, flat, and fringed

Plate CCCCXVI.

at the end; and the legs are naked a little above the knees. The toes are three before and one behind; the laſt of which is ſmall, with a round protuberance beneath it, which is at a little diſtance from the ground. Mr Latham only enumerates two ſpecies: 1. Pſophia crepitans, or gold-breaſted trumpeter. Its head and breaſt are ſmooth and ſhining green. By the Spaniards of Maynas it is called *trompetero*, and by the French at Cayenne *agami*, under which laſt Buffon deſcribes it. It inhabits various parts of South America, Braſil, Guiana, Surinam, &c. but it is moſt plenty in the Amazons country. It is about 20 inches long, being about the ſize of a large fowl, and lays eggs rather larger, of a blue green colour. It is met with in the Carribee iſlands, where it is called a *pheaſant*, and its fleſh is reckoned as good as that of a pheaſant. The moſt characteriſtic and remarkable property of theſe birds conſiſts in the wonderful noiſe they make either of themſelves, or when urged by the keepers of the *menagerie*. Some have ſuppoſed it to proceed from the *anus*, and ſome from the belly. It is now certain, however, that this noiſe proceeds from the lungs. See Buffon, vol. iv. p. 390, &c. Another very remarkable circumſtance is, that they follow people through the ſtreets, and out of town, and that too even perfect ſtrangers. It is difficult to get rid of them; for if you enter a houſe they will wait your return, and again join you, though often after an interval of three hours. "I have ſometimes (ſays M. de la Borde) betaken myſelf to my heels; but they ran faſter, and always got before me; and when I ſtopped, they ſtopped alſo.—I know one (continues he) which invariably follows all the ſtrangers who enter his maſter's houſe, accompanies them into the garden, takes as many turns as they do, and attends them back again. 2. Pſophia undulata, or undulated trumpeter, is about the ſize of a gooſe. The upper part of the body is of a pale reddiſh brown colour, beautifully undulated with black. The head is adorned with a dependent creſt. On each ſide of the neck, beneath the ears, begins a liſt of black, widening as it deſcends, and meeting on the lower part before, where the feathers become greatly elongated, and hang looſely down. The under parts are generally white, the legs are of a duſky blue colour, like the bill. It is a native of Africa: Mr Latham's ſpecimen came from Tripoli.

PSORALEA, in botany: A genus of the decandria order, belonging to the diadelphia claſs of plants; and in the natural method ranking under the 32d order, *Papilionaceæ*. The calyx is powdered, with callous points, and as long as the monoſpermous legumen. The moſt remarkable ſpecies are, 1. The primata or pinnated pſoralea, riſes with a woody ſoft ſtem, branching five or ſix feet high, pinnated leaves of three or four pair of narrow lobes terminated by an odd one, and at the axillas cloſe-ſitting blue flowers with white keels. It is a native of Ethiopia. 2. The bituminoſa, or bituminous trifoliate pſoralea, riſes with a ſhrubby ſtalk, branching ſparingly about two or three feet high, with ternate or three-lobed leaves of a bituminous ſcent, and blue flowers in cloſe heads; it grows in Italy and in France. 3. The aculeata, or aculeated prickly pſoralea, riſes with a ſhrubby branching ſtem three or four feet high, with ternate leaves, having wedge-ſhaped lobes, terminating in a recurved ſharp point, and the branches terminated by roundiſh heads of blue flowers; it grows in Ethiopia. Theſe plants flower here every ſummer; the firſt ſort greateſt part of that ſeaſon, and the others in July and Auguſt; all of which are ſucceeded by ſeeds in autumn. Keep them in pots in order for removing into the green-houſe in winter. They are propagated by ſeeds, ſown in a hot-bed in the ſpring; and when the plants are two or three inches high, prick them in ſeperate ſmall pots, and gradually harden them to the open air, ſo as to bear it fully by the end of May or beginning of June. They may alſo be propagated by cuttings any time in ſummer, planted in pots, and plunged in a little heat, or covered cloſe with hand-glaſſes, ſhaded from the ſun, and watered.

PSYCHOTRIA, in botany: A genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 47th order, *Stellatæ*. The calyx is quinquedentate, perſiſting, and crowning the fruit; the corrolia is tubulated; the berry globoſe; with two hemiſpherical fulcated ſeeds.

The ſpecies are four, viz. 1. Aſpatica; 2. Serpens; 3. Herbacea; and, 4. Emetica. They are all natives of Jamaica. See IPECACUANHA.

PSYLLI, (Strabo, Ptolemy): a people in the ſouth of Cyrenaica, ſo called from king Pſyllus, (Agathargides, quoted by Pliny): almoſt all overwhelmed by ſand driven by a ſouth wind (Herodotus). They had ſomething in their bodies fatal to ſerpents, and their very ſmell proved a charm againſt them, according to Pliny, Lucan, &c.

Though we may juſtly look upon it as fabulous, that theſe people had any thing in their bodies different from others; it is, however, certain that there are in Egypt at this day ſome perſons who have a method of handling the moſt poiſonous ſerpents without any hurt. Of theſe Mr Haſſelquiſt gives the following account:

"They take the moſt poiſonous vipers with their bare hands, play with them, put them in their boſoms, and uſe a great many more tricks with them, as I have often ſeen. I have frequently ſeen them handle thoſe that were three or four feet long, and of the moſt horrid ſort. I enquired and examined whether they had cut out the vipers poiſonous teeth; but I have with my own eyes ſeen they do not. We may therefore conclude, that there are to this day Pſylli in Egypt; but what art they uſe is not eaſily known. Some people are very ſuperſtitious, and the generality believe this to be done by ſome ſupernatural art which they obtain from inviſible beings. I do not know whether their power is to be aſcribed to good or evil; but I am perſuaded that thoſe who undertake it uſe many ſuperſtitions.

"The art of faſcinating ſerpents is a ſecret amongſt the Egyptians. It is worthy the endeavours of all naturaliſts, and the attention of every traveller, to learn ſomething deciſive as to this affair. How ancient this art is among the Africans, may be concluded from the ancient Marii and Pſylli, who were from Africa, and daily ſhowed proofs of it at Rome. It is very remarkable that this ſhould be kept a ſecret for more than 2000 years, being known only to a few, when we have ſeen how many other ſecrets have within that time been revealed. The circumſtances relating to the faſcination of ſerpents in Egypt, related to me, were principally, 1. That the art is only known to certain families, who propagate it to their offspring. 2. The perſon who knows how to faſcinate ſerpents, never meddles with other poiſonous animals, ſuch as ſcorpions, lizards, &c. There are different perſons who know how to faſcinate theſe animals; and they again never meddle with ſerpents. 3. Thoſe that faſcinate ſerpents, eat them both raw and boiled, and even make broth of them, which they eat very commonly amongſt them; but in particular, they eat ſuch a diſh when they go out to catch them. I have been told, that ſerpents fried or boiled are frequently eat by the Arabians both in Egypt and Arabia, though they know not how to faſcinate them, but catch them either alive or dead. 4. After they have eat their ſoup, they procure a bleſſing from their ſcheik (prieſt or lawyer), who uſes ſome ſuperſtitious ceremonies, and amongſt others, ſpits on them ſeveral times with certain geſtures. This manner of getting a bleſſing from the prieſt is pure ſuperſtition, and certainly cannot in the leaſt help to faſcinate ſerpents; but they believe, or will at leaſt perſuade others, that the power of faſcinating ſerpents depends upon this circumſtance."

Notwithſtanding this teſtimony of Haſſelquiſt, the ſtory of the incantation of ſerpents, though frequently alluded to in Scripture, has been generally treated as a fable. It is, however, affirmed as a certain truth, both by Mr Bruce and M. Savary. "There is no doubt (ſays the former of theſe travellers) of its reality. The Scriptures are full of it. All that have been in Egypt have ſeen as many different inſtances as they choſe. Some have doubted that it was a trick; and that the animals thus handled had been firſt trained, and then deprived of their power of hurting; and fond of the diſcovery, they have reſted themſelves upon it, without experiment, in the face of all antiquity. But I will not heſitate to aver, that I have ſeen at Cairo (and this may be ſeen daily without any trouble or expence), a man who came from the catacombs, where the pits of the mummy birds are kept, who has taken a ceraſtes with his naked hand from a number of others lying at the bottom of a tub, has put it upon his bare head, covered it with the common red cap he wears, then taken it out, put it in his breaſt, and tied it about his neck like a necklace; after which it has been applied to a hen, and bit it, which died in a few minutes; and, to complete the experiment, the man has taken it by the neck, and beginning at his tail, has ate it as one would do a carrot or ſtock of celery, without any ſeeming repugnance.

"We know from hiſtory, that where any country has been remarkably infeſted with ſerpents, there the people have been ſcreened by this ſecret.

"To leave ancient hiſtory, I can myſelf vouch, that all the black people in the kingdom of Sennaar, whether Funge or Nuba, are perfectly armed againſt the bite of either ſcorpion or viper. They take the ceraſtes in their hands at all times, put them in their boſoms, and throw them to one another as children do apples or balls, without having irritated them by this uſage ſo much as to bite. The Arabs have not this ſecret naturally, but from their infancy they acquire an exemption from the mortal conſequences attending the bite of theſe animals, by chewing a certain root, and waſhing themſelves (it is not anointing) with an infuſion of certain plants in water."

From this account we ſhould be apt to think, that theſe vipers really *would not* bite any who were thus armed againſt their poiſon; eſpecially as he adds, that he "conſtantly obſerved, that the viper, however lively before, upon being ſeized by any of theſe barbarians, ſeemed as if taken with ſickneſs and feebleneſs, frequently ſhut his eyes, and never turned his mouth towards the arm of the perſon who held him." Yet in another place, ſpeaking of the activity of the ceraſtes, he ſays, "I ſaw one of them at Cairo, in the houſe of Julian and Roſa, crawl up the ſide of a box in which there were many, and there lie ſtill, as if hiding himſelf, till one of the people who brought them to us came near him; and though in a very diſadvantageous poſture, ſticking as it were perpendicularly to the ſide of the box, he leaped near the diſtance of three feet, and faſtened between the man's forefinger and thumb ſo as to bring the blood. The fellow ſhowed no ſigns of either pain or fear, and even kept him with us full four hours, without his applying any ſort of remedy, or ſeeming inclined to do ſo."

It is difficult to ſee how theſe two accounts can be reconciled. If thoſe who catch vipers are in danger of being bit by them *after* they are catched, certainly they muſt be ſo before, and then the whole relation becomes contradictory. Our author tells us, that theſe feats were performed *for a ſeaſon*, by thoſe who were artificially armed againſt the viper's poiſon, as well as thoſe who had the exemption naturally; but though put in poſſeſſion of the drugs, he never had the courage to make the experiment. That he ſhould have made ſuch a dreadful experiment on *himſelf*, no perſon in his ſenſes would expect; but it is indeed very ſurpriſing, that he did not attempt by means of theſe medicines to arm ſome of the brute creatures, of the lives of which he was ſufficiently prodigal, againſt the effects of that deadly poiſon by which ſo many of them periſhed.—As ſurpriſing it is, that he did not try what effect the root or its decoction would have upon the ſerpents themſelves; or that though he ſays he had a ſmall quantity of this extraordinary root by him, he gave neither drawing nor deſcription of it.

Though it is impoſſible to reconcile the particulars of this account to one another, the general fact of the incantation is confirmed by the teſtimony of M. Savary. This writer tells us, that he ſaw at the feaſt of Sidi Ibrahim, a troop of people, ſeemingly poſſeſſed, with naked arms and a fierce look, holding in their hands enormous ſerpents, which twined round their body, and endeavoured to eſcape. Theſe Pſylli, graſping them ſtrongly by the neck, avoided the bite; and notwithſtanding their hiſſing, tore them with their teeth, and ate them alive, while the blood ſtreamed from their mouth.

PTARMIGAN, in ornithology. See TETRAO.

PTELEA, SHRUB-TREFOIL: A genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking with thoſe of which the order is doubtful. The corolla is tetrapetalous; the calyx quadripartite inferior; the fruit is monoſpermous, with a roundiſh membrane in the middle.

The ſpecies are, 1. The trifoliata, or Carolina ſhrub-trefoil, hath a ſhrubby upright ſtem, dividing into a branchy head eight or ten feet high, covered with a ſmooth purpliſh bark, trifoliate leaves, formed of oval ſpear-ſhaped folioles, and the branches terminated by large bunches of greeniſh-white flowers, ſucceeded by roundiſh, bordered capſules. 2. The viſcoſa, or viſcous Indian ptelea, riſes with ſeveral ſtrong ſhrubby ſtems, branching erectly 12 or 15 feet high, having a light brown bark, ſpear-ſhaped, ſtiff, ſimple leaves, and the branches terminated by cluſters of greeniſh flowers.

The firſt ſpecies is a hardy deciduous ſhrub, and a proper plant for the ſhrubbery and other ornamental plantations to increaſe the variety. It is propagated by ſeeds, layers, and cuttings.

The ſecond ſpecies is a ſtove-plant, and is propagated commonly by ſeeds.

PTERIS, in botany; a genus of the order of filices, belonging to the cryptogamia claſs of plants. The fructifications are in lines under the margin. There are 19 ſpecies; the moſt remarkable is the aquilina, or common female fern. The root of this is viſcid, nauſeous, and bitteriſh; and like all the reſt of the fern tribe, has a ſalt, mucilaginous taſte. It creeps under the ground in ſome rich ſoils to the depth of five or ſix feet, and is very difficult to be deſtroyed. Frequent mowing in paſture-grounds, plentiful dunging in arable lands, but, above all, pouring urine upon it, are the moſt approved methods of killing it. It has, however, many good qualities to counterbalance the few bad ones. Fern cut while green, and left to rot upon the ground, is a good improver of land; for its aſhes, if burnt, will yield the double quantity of ſalt that moſt other vegetables will.—Fern is alſo an excellent manure for potatoes; for if buried beneath their roots, it never fails to produce a good crop.—Its aſtringency is ſo great, that it is uſed in many places abroad in dreſſing and preparing kid and chamois leather.—In ſeveral places in the north, the inhabitants mow it green, and, burning it to aſhes, make thoſe aſhes up into balls, with a little water, which they dry in the ſun, and make uſe of them to waſh their linen with inſtead of ſoap. In many of the Weſtern Iſles the people gain a very conſiderable profit from the ſale of the aſhes to ſoap and glaſs-makers.—In Glen Elg in Inverneſsſhire, and other places, the people thatch their houſes with the ſtalks of this fern, and faſten them down with ropes made either of birk-bark or heath. Sometimes they uſe the whole plant for the ſame purpoſe, but that does not make ſo durable a covering.—Swine are fond of the roots, eſpecially if boiled in their waſh.—In ſome parts of Normandy we read that the poor have been reduced to the miſerable neceſſity of mixing them with their bread. And in Siberia, and ſome other northern countries, the inhabitants brew them in their ale, mixing one-third of the roots to two-thirds of malt.—The ancients uſed the root of this fern, and the whole plant, in decoctions and diet-drinks, in chronic diſorders of all kinds, ariſing from obſtructions of the viſcera and the ſpleen. Some of the moderns have given it a high character in the ſame intentions, but it is rarely uſed in the preſent practice. The country people, however, ſtill continue to retain ſome of its ancient uſes; for they give the powder of it to deſtroy worms, and look upon a bed of the green plant as a ſovereign cure for the rickets in children.

PTEROCARPUS, in botany: A genus of the decandria order, belonging to the diadelphia claſs of plants; and in the natural method ranking under the 32d order, *Papilionaceæ*. The calyx is quinquedentate, the capſule falcated, filiaceous, varicoſe. The ſeeds are few and ſolitary. There are four ſpecies, viz. 1. *Draco*; 2. *Ecaſtaphyllum*; 3. *Lunatus*; and, 4. *Santalinus*. This laſt is by ſome referred to the genus *Santalum*. It is called *red ſaunders*; and the wood is brought from the Eaſt Indies in large billets, of a compact texture, a dull red, almoſt blackiſh colour on the outſide, and a deep brighter red within. This wood has no manifeſt ſmell, and little or no taſte. It has been commended as a mild aſtringent, and a corroborant of the nervous ſyſtem: but theſe are qualities that belong only to the yellow ſort.

The principal uſe of red ſaunders is as a colouring drug; with which intention it is employed in ſome formulæ, particularly in the *tinctura lavendulæ compoſita*. It communicates a deep red to rectified ſpirit, but gives no tinge to aqueous liquors; a ſmall quantity of the reſin, extracted by means of ſpirit, tinges a large one of freſh ſpirit of an elegant blood-red. There is ſcarcely any oil, that of lavender excepted, to which it communicates its colour. Geoffroy and others take notice, that the Brazil woods are ſometimes ſubſtituted for red ſaunders; and the college of Bruſſels are in doubt whether all that is ſold among them for ſaunders be not really a wood of that kind. According to the account which they have given, their ſaunders is certainly the Brazil wood; the diſtinguiſhing character of which is, that it imparts its colour to water.

PTEROCOCEUS, in botany, is a ſpecies of the genus Calligonum. See CALLIGONUM.

PTERONIA, in botany: A genus of the polygamia equalis order, belonging to the ſyngeneſia claſs of plants; and in the natural method ranking under the 49th order, *Compoſitæ*. The receptacle is full of multipartite briſtles; the pappus a little plumy; the calyx imbricated.

PTEROSPERMUM, in botany: A genus of the polyandria order, belonging to the monodelphia claſs of plants; and in the natural method ranking under the 37th order, *Columniferæ*. The calyx is quinquepartite; the corolla conſiſts of five oblong ſpreading petals. The filaments are about 15, which unite towards the baſe into a tube. The ſtyle is cylindrical; the capſule is oval, woody, and quinquelocular, each of which are bivalved, containing many oblong, compreſſed, and winged ſeeds. There is only one ſpecies, viz. the *Pentapetes*, a native of the Eaſt Indies; the wood of which is very hard, and very like that of the holly-tree.

PTINUS, a genus of inſects belonging to the order of coleoptera. The antennæ are filiform: The laſt or exterior articulations are longer than the others: The thorax is nearly round, without a margin, into which the head is drawn back or received: The feet are made for leaping. The moſt remarkable ſpecies are,

1. The pectinicornis. This is produced from a worm that lodges in wood and the trunks of trees, ſuch as the willow, where it makes deep round holes, turns to a winged inſect, takes flight, and rooſts upon flowers. It is diſtinguiſhed by its antennæ pectinated on one

ſide, whence it has the name of *feathered*. The elytra and thorax are of a deep clay-coloured brown, the antennæ and legs are of a pale brown.

2. The pertinax. The form of this inſect reſembles the preceding one, ſaving that its antennæ are filiform. It is all over of a deep blackiſh brown colour reſembling ſoot. It attacks houſehold-furniture, cloathes, furs, and eſpecially animals dried and preſerved in collections of natural hiſtory, where it makes great havock. When caught, this inſect bends its legs, draws back its head, and lies as if it was dead till it thinks itſelf out of danger. It cannot be forced out of this ſtate of inaction either by pricking or tearing: nothing but a ſtrong degree of heat can oblige it to reſume its motion and run away. There are many beautiful varieties of this genus; but they in general eſcape our attention by their minuteneſs, and living among hay, dried leaves, and divers other duſty matters, where they undergo their metamorphoſes. The larvæ of ſome are found in trunks of decayed trees, in old tables, chairs, &c. See Plate CCCCXVI.

PTISAN, is properly barley decorticated, or deprived of its hulls, by beating in a mortar, as was the ancient practice; though the cooling potion obtained by boiling ſuch barley in water, and afterwards ſweetening the liquor with liquorice-root, is what at preſent goes by the name of *Ptiſan*; and to render it laxative, ſome add a little ſenna or other ingredient of the ſame intention.

PTOLEMAIC *Syſtem of Aſtronomy*, is that invented by Claudius Ptolemæus. See PTOLEMY) Claudius).

PTOLEMAIS, (anc. geog.); the port of Arſinoe, ſituated on the weſt branch of the Nile, which concurs to form the iſland called *Nomos Heracleotes*, to the ſouth of the vertex of the Delta.

PTOLEMAIS (Strabo); the largeſt and moſt conſiderable town of the Thebais, or Higher Egypt, and in nothing ſhort of Memphis; governed in the manner of a Greek republic; ſituated on the weſt ſide of the Nile, almoſt oppoſite to Coptos. This town, which was built by Ptolemy Philadelphus, is now known by the name of *Ptolometa*. The walls and gates are ſtill entire, and there are a vaſt number of Greek inſcriptions, but only a few columns of the portico remain. There is likewiſe an Ionic temple, done in the moſt ancient manner of executing that order, of which Mr Bruce took a drawing, which is preſerved in the king's collection.—Another, of Cyrenaica, anciently called *Barce*.—A third of the Troglodytica, ſurnamed *Epitheras*, from the chace of wild beaſts, as elephants: lying in the ſame parallel with Meroe (Strabo); on the Arabian gulf (Pliny); 4820 ſtadia to the ſouth of Berenice.—A fourth, of Galilee, anciently called *Aca*, or *Acon*; made a Roman colony under the emperor Claudius (Pliny).—A fifth of Pamphylia; ſituated near the river Melas, on the borders of Cilicia Aſpera.

PTOLEMY (Soter, or Lagus), king of Egypt, a renowned warrior, end an excellent prince: he eſtabliſhed an academy at Alexandria, and was himſelf a man of letters. Died 284 B. C. aged 92.

PTOLEMY (Philadelphus), his ſecond ſon, ſucceeded him to the excluſion of Ptolemy Ceraunus. He was renowned as a conqueror, but more revered for his great virtues and political abilities. He eſtabliſhed and augmented the famous Alexandrian library, which had been begun by his father. He greatly increaſed the commerce of Egypt, and granted conſiderable privileges to the Jews, from whom he obtained a copy of the Old Teſtament, which he cauſed to be tranſlated into Greek, and depoſited in his library. This is ſuppoſed to have been the verſion called the *Septuagint*. He died 246 years B.C. aged 64.

PTOLEMY (Ceraunus), the elder brother, fled to Seleucus king of Macedon, who received him hoſpitatably; in return for which he aſſaſſinated him, and uſurped his crown. He then invited Arſinoe, who was his widow and his own ſiſter, to ſhare the government with him; but as ſoon as he got her in his power, he murdered her and her children. He was at length defeated, killed, and torn limb from limb by the Gauls, 279 B. C.

PTOLEMY (Claudius), a celebrated mathematician and aſtrologer, was born at Peluſium, and ſurnamed by the Greeks *Moſt Divine* and *Moſt Wiſe*. He flouriſhed at Alexandria in the ſecond century, under the reigns of Adrian and Marcus Aurelius, about the 138th year before the Chriſtian era. There are ſtill extant his Geography, and ſeveral learned works on aſtronomy. The principal of which are, 1. The Almageſt; 2. *De Judiciis Aſtrologicis*; 3. *Planiſphærium*. His ſyſtem of the world was for many years adopted by the philoſophers and aſtronomers; but the learned have rejected it for the ſyſtem of Copernicus. See ASTRONOMY, nº 16.

PTYALISM, in medicine, a ſalivation, or frequent and copious diſcharge of ſaliva. The word is Greek, formed from πτυω "to ſpit."

PUBERTY, denotes the age at which a perſon is capable of procreating or begetting children. See MAN nº 13—18.

PUBERTY, in law, is fixed at the age of 12 in females, and 14 in males; after which they are reckoned to be fit for marriage. But as to crimes and puniſhments, the age of puberty is fixed at 14 in both ſexes.

PUBES, in anatomy, denotes the middle part of the hypogaſtric region in men or women, lying between the two inguina or groins.

Section of the PUBES. See MIDWIFERY and *SIGAULTIAN Operation*.

PUBES, in botany, the hair or down on the leaves of ſome planſs. See HAIR.

PUBLICAN, among the Romans, one who farmed the taxes and public revenues.

PUBLICATION, the art of making a thing known to the world, the ſame with promulgation.

PUBLIUS SYRUS, a Syrian mimic poet, who flouriſhed about 44 years before Chriſt. He was originally a ſlave ſold to a Roman patrician, called *Domitius*, who brought him up with great attention, and gave him his freedom when of age. He gained the eſteem of the moſt powerful men at Rome, and reckoned J. Cæſar among his patrons. He ſoon eclipſed the poet Laberius, whoſe burleſque compoſitions were in general eſteem. There remains of Publius, a collection of moral ſentences, written in iambics, and placed in alphabetical order.

Oak PUCERON, a name given by naturaliſts to a very remarkable ſpecies of animal of the puceron kind. They bury themſelves in the cleſts of the oak and ſome other trees, and getting into the crevices, where the bark is a little ſeparated from the wood, they there live at eaſe, and feed to their fill, without being expoſed to their common enemies. They are larger than the other pucerons, the winged ones being nearly as large as a common houſe fly; and thoſe without wings are alſo larger than any other ſpecies of the ſame genus. The winged ones are black, and the others of a coffee colour. Their trunk is twice the length of their bodies, and, when walking, it is carried ſtraight along the belly, trailing behind it with the point up. When the creature has a mind to ſuck a part of the tree that is juſt before it, it draws up, and ſhortens the trunk, till it brings it to a proper length and direction; but when it ſucks in the common way, it crawls upon the inner ſurface of the bark, and the turned up end of the trunk, which reſembles a tail, fixes itſelf againſt the wood that is behind it, or contiguous to is back, and ſucks there. The extremity of this trunk holds ſo faſt by the wood, that when it is pulled away, it frequently brings a ſmall piece of the wood away with it.

The ants are as fond of theſe as of the other ſpecies of pucerons, and that for the ſame reaſon, not feeding upon them, but on their dung, which is a liquid matter of a ſweet taſte, and is the natural juice of the tree, very little altered. Theſe creatures are the ſureſt guides where to find this ſpecies of puceron; for if we at any time ſee a number of theſe crawling up an oak to a certain part, and there creeping into the cleſts of the bark, we may be aſſured that in that place there are quantities of theſe oak pucerons. The ants are ſo extremely fond of the juices of the tree, when prepared for them by paſſing through the body of this animal, that when the puceron has a drop not yet evacuated, but hanging only in part out at the paſſage, an ant will often ſeize on it there.

Pucerons, *Vine-fretters*, or *Plant-lice*. See Aphis.

PUDENDA, the parts of generation in both ſexes. See Anatomy, n° 107 and 108.

PUERILITY, in diſcourſe, is defined by Longinus to be a thought which, by being too far fetched, becomes flat and inſipid. Puerility, he adds, is the common fault of thoſe who affect to ſay nothing but what is brilliant and extraordinary.

PUFFENDORF (Samuel de) was born in 1631 at Fleh, a little village in Miſnia, a province in Upper Saxony; and was ſon of Elias Puffendorf, miniſter of that place. After having made great progreſs in the ſciences at Leipſic, he turned his thoughts to the ſtudy of the public law, which in Germany conſiſts of the knowledge of the rights of the empire over the princes and ſtates of which it is compoſed, and thoſe of the princes and ſtates with reſpect to each other. But though he uſed his utmoſt efforts to diſtinguiſh himſelf, he deſpiſed thoſe pompous titles which are ſo much ſought for at univerſities, and never would take the degree of doctor. He accepted the place of governor to the ſon of Mr Coyet, a Swediſh nobleman, who was then ambaſſador from Sweden to the court of Denmark. For this purpoſe he went to Copenhagen, but continued not long at eaſe there; for the war being renewed ſome time after between Denmark and Sweden, he was ſeized with the whole family of the ambaſſador. During his confinement, which laſted eight months, as he had no books, and was allowed to ſee no perſon, he amuſed himſelf by meditating on what he read in Grotius's treatiſe *De Jure Belli et Pacis*, and the political writings of Mr Hobbes. Out of theſe he drew up a ſhort ſyſtem, to which he added ſome thoughts of his own, and publiſhed it at the Hague in 1660, under the title of *Elementa Juriſprudentiæ Univerſalis*. This recommended him to the elector Palatine, who invited him to the univerſity of Heidelberg, where he founded in his favour a profeſſorſhip of the law of nature and nations, which was the firſt of that kind eſtabliſhed in Germany. Puffendorf remained at Heidelberg till 1673, when Charles XI. of Sweden gave him an invitation to be profeſſor of the law of nature and nations at Lunden; which place the elector Palatine reluctantly allowed him to accept. He went thither the ſame year; and after that time his reputation greatly increaſed. Some years after, the king of Sweden ſent for him to Stockholm, and made him his hiſtoriographer, and one of his counſellors. In 1688, the elector of Brandenburg obtained the conſent of his Swediſh majeſty, that he ſhould come to Berlin, in order to write the hiſtory of the elector William the Great; and in 1694 made him a baron. But he died that ſame year of an inflammation in his feet, occaſioned by cutting his nails; having attained his grand climacteric. Of his works, which are numerous, the following are the principal: 1. A Treatiſe on the Law of Nature and Nations, written in German; of which there is an Engliſh tranſlation with Barbeyrac's Notes. 2. An Introduction to the Hiſtory of the Principal States which at preſent ſubſiſt in Europe; written in German; which has been alſo tranſlated into Engliſh. 3. The Hiſtory of Sweden, from Guſtavus Adolphus's expedition into Germany to the abdication of Queen Chriſtina. 4. The Hiſtory of Charles Guſtavus, two volumes folio, &c.

PUFFIN. See Alca, n° 3.

PUGET (Peter Paul), one of the greateſt painters and ſculptors France ever produced, though but little noticed by their own writers, was born at Marſeilles in 1623. In his youth he was the diſciple of Roman, an able ſculptor; and then went to Italy, where he ſtudied painting and architecture. In painting he ſo well imitated the manner of Peter de Cortona, that this painter deſired to ſee him, and entered into a friendſhip with him. In 1657, a dangerous diſorder obliged him to renounce the pencil, and devote himſelf to ſculpture; and his reputation cauſing him to be invited to Paris, he enjoyed a penſion of 1200 crowns, as ſculptor and director of the works relating to veſſels and galleys. He died at Marſeilles in 1695, and has left a number of admirable ſtatues behind him both in France and Italy.

PUGIL, in phyſic, &c. ſuch a quantity of flowers, ſeeds, or the like, as may be taken up between the thumb and two fore-fingers. It is reckoned the eighth part of the manipulus or handful.

PULEGIUM, or Penny-Royal. See Mentha.

PULEX, the Flea, in zoology, a genus of inſects belonging to the order of aptera. It has two eyes, and

Pulex.

and ſix feet fitted for leaping; the feelers are like threads; the roſtrum is inflected, ſetaceous, and armed with a ſting; and the belly is compreſſed.

The generation of this familiar vermin affords ſomething very curious, firſt diſcovered by Sig. Diaciento Ceſtore. Fleas bring forth eggs, or nits, which they depoſit on animals that afford them a proper food: theſe eggs being very round and ſmooth, uſually ſlip ſtraight down; unleſs detained by the piles or other inequalities, of the clothes, hairs, &c. Of theſe eggs are hatched white worms, of a ſhining pearl colour, which feed on the ſcurfy ſubſtance of the cuticle, the downy matter gathered in the piles of clothes, or other the like ſubſtances. In a fortnight they come to a tolerable ſize, and are very lively and active; and, if at any time diſturbed, they ſuddenly roll themſelves into a kind of ball. Soon after this, they come to creep, after the manner of ſilk-worms, with a very ſwift motion. When arrived at their ſize, they hide themſelves as much as poſſible, and ſpin a ſilken thread out of their mouth, wherewith they form themſelves a ſmall round bag, or caſe, white within as paper, but without always dirty, and fouled with duſt. Here, after a fortnight's reſt, the animalcule burſts out, transformed into a perfect flea; leaving its exuvia in the bag. While it remains in the bag, it is milk-white, till the ſecond day before its eruption; when it becomes coloured, grows hard, and gets ſtrength; ſo that upon its firſt delivery it ſprings nimbly away.

The flea, when examined by the microſcope, affords a very pleaſing object. It is covered all over with black, hard, and ſhelly ſcales or plates, which are curiouſly jointed, and folded over one another in ſuch a manner as to comply with all the nimble motions of the creature. Theſe ſcales are all curiouſly poliſhed, and are beſet about the edges with ſhort ſpikes in a very beautiful and regular order. Its neck is finely arched, and much reſembles the tail of a lobſter: the head alſo is very extraordinary; for from the ſnout-part of it there proceed the two fore-legs, and between theſe is placed the piercer or ſucker with which it penetrates the ſkin to get its food. Its eyes are very large and beautiful, and it has two ſhort horns or feelers. It has four other legs joined all at the breaſt. Theſe, when it leaps, fold ſhort one within another; and then, exerting their ſpring all at the ſame inſtant, they carry the creature to a ſurpriſing diſtance. The legs have ſeveral joints, and are very hairy, and terminate in two long and hooked ſharp claws. The piercer or ſucker of the flea is lodged between its fore-legs, and includes a couple of darts or lancets; which, after the piercer has made an entrance, are thruſt farther into the fleſh, to make the blood flow from the adjacent parts and occaſion that round red ſpot, with a hole in the centre of it, vulgarly called a *flea-bite*. This piercer, its ſheath opening ſidewiſe and the two lancets within it, are very difficult to be ſeen; unleſs the two fore-legs, between which they are hid, be cut off cloſe to the head: for the flea rarely puts out its piercer, except at the time of feeding, but keeps it folded inwards; and the beſt way of ſeeing it is by cutting off firſt the head, and then the fore-legs, and then it is uſually ſeen thruſt out in convulſions.

By keeping fleas in a glaſs tube corked up at both ends, but ſo as to admit freſh air, their ſeveral actions may be obſerved, and particularly their way of coupling, which is performed tail to tail; the female, which is much the larger, ſtanding on the male. They may alſo be thus ſeen to lay their eggs, not all at once, but ten or twelve in a day, for ſeveral days ſucceſſively; which eggs will be afterwards found to hatch ſucceſſively in the ſame order. The flea may eaſily be diſſected in a drop of water; and by this means the ſtomach and bowels, with their periſtaltic motion, may be diſcovered very plainly, as alſo their teſtes and penis, with the veins and arteries, though minute beyond all conception. Mr Lieuwenhoek affirms alſo, that he has ſeen innumerable animalcules, ſhaped like ſerpents, in the ſemen maſculinum of a flea. This blood-thirſty inſect, which fattens at the expence of the human ſpecies, prefers the more delicate ſkin of women; but preys neither upon epileptic perſons, nor upon the dead or dying. It loves to neſtle in the fur of dogs, cats, and rats. The neſts of river-ſwallows are ſometimes plentifully ſtored with them.

Barbut's Genera of Inſects, p. 330, &

Fleas are apterous; walk but little, but leap to a height equal to 200 times that of their own body. This amazing motion is performed by means of the elaſticity of their feet, the articulations of which are ſo many ſprings. Thus it eludes, with ſurpriſing agility, the purſuit of the perſon on whom it riots.—Among the memorabilia of fleas, one, they ſay, has been ſeen to draw a ſmall ſilver piece of ordnance to which it was faſtened, the firing of the gun nowiſe daunting its intrepidity. The owner carried it about in a little box lined with velvet, every now and then placing it on her arm to let it feed; but winter put an end to the being of this martial flee. Another flea that became ſlave to an Engliſhman, had for its daily and eaſy taſk to drag its golden chain and padlock, of the weight of one grain. A third flea ſerved as a thrill-horſe to an Engliſh artiſt, who had made an ivory coach and ſix, that carried a coachman with his dog between his legs, a poſtilion two footmen, and four inſide riders. At Surat fleas, bugs, and other voracious vermin are in ſo great veneration, that they have an hoſpital endowed, where every night a poor fellow, for hire, ſuffers himſelf to be preyed upon. He is faſtened naked on a bed, when the feaſt begins at his expence. In Turkey there is a ſimilar foundation for decayed dogs; an inſtitution leſs ridiculous than the other. Mercurial ointment, brimſtone, a fumigation with the leaves of penny-royal, or freſh-gathered leaves of that plant ſewed up in a bag, and laid in the bed, are remedies pointed out as deſtructive of fleas.

Pulex-Arboreus, in natural hiſtory the name given by Mr Reaumur to a very large genus of ſmall animals. They are a kind of half-winged creatures: they have granulated antennæ; and ſome of them, in their moſt perfect ſtate, have complete wings. Theſe are diſtinguiſhed from the others by the name of *muſca-pulex* or the *winged pulex*.

The ſeveral ſpecies of theſe creatures are of different colours: ſome are brown, others yellow: but the moſt frequent are green. They all feed upon the leaves of trees, which become withered and curled up on their eroding them; and they are ſo common, that wherever a leaf of a tree is found curled up, or of a different form from the others, it is highly probable theſe animals are on it, or that it is their work. Among trees the willow and the roſe are the moſt infected by them; and among plants, the bean and the poppy. They live a ſocial life, multitudes of males and females being found together. The females are eaſily diſtinguiſhed from the males, by their being thicker in the body, and having larger bellies.

It is very wonderful, that of all the known animals of the winged kind, theſe are the only ones which are viviparous. This is eaſily ſeen beyond a poſſibility of doubt; for, on examining a cluſter of them together, it is a common thing to ſee, by the help of a ſmall magnifier, a female in the act of parturition; and the author* of this account frequently ſaw the young pulex protruded out, from a paſſage near the anus of the female, perfectly formed. He had ſuſpected this from the total want of eggs among ſo numerous a tribe of animals, and from their remarkably ſpeedy propagation, and was thus convinced of it by ocular demonſtration.

They are armed with a tender and flexile proboſcis; with which they ſeize hold of the young ſhoots of the tree they live upon, twiſting the proboſcis round it. Theſe creatures are always ſeen naked and expoſed, ſtanding on the outſide of the ſtalks and leaves, and ſucking in their juices for nouriſhment with their proboſcis. But there is another ſpecies of them, which are alike viviparous, and agree with them in all reſpects except in their manner of living. Theſe get into the inner ſubſtance of the leaves, like the worms called *aſcarides*; and feed on the parenchyma, being defended from all injuries by living between the integuments. In this caſe, the leaves they bury themſelves in become ſcabrous and deformed, and produce a ſort of galls; ſo that Malphigi erred in ſuppoſing all the galls of trees to be produced by the animals hatched of the eggs of ichneumon flies; ſince theſe animals, which are viviparous, and are of a very different kind from the worms of the ichneumon flies, equally produce them. A female of the ſpecies here treated of has been ſeen to bring forth ſeven young ones in a day: and thus from reſiding alone in the tubercles which ſhe had formed on a leaf, ſhe in a little time becomes the mother of a numerous family; each of which raiſes its own tumour or gall on the leaf, which at firſt are ſmall and round, and of a beautiful red like kermes.

Such of theſe as are of the male ſpecies have a certain time of reſt, in which they lie buried in a ſilky matter, and afterwards become winged, flying nimbly about; whereas the females never are able to fly, but remain always half-winged. It is to be obſerved, however, that there is a different ſpecies of winged inſects frequently found flying about the female pulices, as well as their own males; ſo that all the ſmall-winged inſects about them are not to be thought of their own ſpecies. Theſe do not greatly differ in figure; but the one are harmleſs, and the others have ſtings, and hurt any part of the body on which they fix.

PULEX *Aquaticus auctorum* (*monoculus pulex* of Linnæus), in entymology, is a ſpecies of the genus MONOCULUS, which ſee. It is a moſt curious inſect of the ſize of a flea, and has been noticed by many writers who have examined its parts with accuracy, and is that which, uniting together in vaſt numbers, occaſions the beautiful red patches which may be obſerved in a dry ſummer ſeaſon on ſtagnant waters, giving riſe to reports of water being turned to blood, and in the minds of the leſs informed thought to portend dire events. The other ſpecies of the ſame genus collect on waters in a ſimilar way, and occaſion a ſimilar appearance, as has been mentioned under the generic name, to which we refer our readers. See alſo Swammerdam's *Book of Nature*, p. 39; Baker's *Employment for the Microſcope*, p. 302.; Schœffer's *Icon. Inſ.*; Sultz. *Inſ.* p. 30: De Seer's *Inſ.* vol. 7. &c. where there are alſo excellent figures of it. We have given a figure of it magnified and drawn from life: The outward form of the body, Swammerdam ſays, is a kind of ſquare; under the eye there is a ſharp beak; on the breaſt are a kind of arms divided into branches like the boughs of trees, and in the abdomen there is a tranſparent ſubſtance with the legs and tail, and in the hinder part of the body, its legs appear placed as it were on the middle of the back: The eyes are almoſt cloſe together, and are reticulated; the beak is tranſparent.

Plate CCCCXVI.

It appears that inſects of this tribe are enabled to bear the extremes of heat and cold: for Ray, in his *Hiſtoria Inſectorum*, p. 41, obſerves, that the *pulex fluviatilis* was met with by Mr Willoughby in a hot bath near Vicenza in Italy the temperature of which was ſuch as to prevent any other living therein; and, on the contrary, O. Fabricius, in his *Fauna Grœnlandiæ*, p. 264. mentions the circumſtance of the *monoculus pulex* being frequently found under the ice in the ſtagnant waters of Greenland.

The chego, or *pulex minimus, cutem penetrans, Americanus* of Cateſby, is a very ſmall animal found in warm climates. It is a very troubleſome inſect, eſpecially to negroes and ſuch as are ſlovenly or go barefooted. They penetrate the ſkin, under which they lay a bunch of eggs, which ſwell to the bigneſs of a ſmall pea or tare. They are exceedingly painful; and unleſs great care is uſed in taking them out, they are dangerous. It is about one-fourth the ſize of a common flea; the figure is conſiderably magnified. From the mouth iſſues a hollow tube like that of a common flea, between a pair of antennæ. It has ſix jointed legs, and ſomething like a tail. Under it is one of its eggs, which is ſcarcely viſible to the naked eye. Theſe animals are a great nuiſance to moſt parts of America between the tropics. See Sir Hans Sloane's, *Hiſtory of Jamaica*, Introd. p. cxxiv. and vol. ii. 191, 192.

Plate CCCCXVI.

PULEX-*Eaters*, a name given by naturaliſts to a ſort of worms frequently found on the leaves of trees, where they devour the animals called *pulices arborei*.

Of theſe there are ſeveral ſpecies, which owe their origin to the eggs of different creatures; for there are none of them in their ultimate ſtate in this their time of feeding. According to the different animals whoſe eggs they are hatched from, theſe are of different form and ſtructure. Some are hexapodes, or endued with ſix feet; theſe belong to the beetle-tribe, and finally change into beetles like the parent animal from whoſe eggs they ſprung. Others have no legs, and are produced from the eggs of flies of various kinds. And, finally, others are genuine caterpillars, though ſmall; but theſe are the moſt rare of all.

The two general kinds are the hexapodes, or beetle-worms; and the apodes, or fly-worms. The fly which gives origin to the laſt of theſe is a four-winged one; and takes care always to depoſit her eggs in a place where there are plenty of the pulices, uſually on the ſtalk or young branches of a tree in the midſt of large families of them. The worm, as ſoon as hatched, finds itſelf in the midſt of abundance of food, preying at pleaſure on theſe animals, which are wholly defenceleſs. The ſtalks of the elder and woodbine are frequently found covered over with theſe pulices; and among them there may uſually be found one or more of theſe deſtroyers feeding at will, ſucking in the juices from their bodies, and then throwing away the dry ſkins. Beſides the worms of this four-winged fly, there is one of a two-winged waſp-fly, very deſtructive of theſe animals.

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*Reaumurs, Hiſtory of Inſects.

PULLEY, in mechanics, one of the five mechanical powers. See MECHANICS, p. 739.

PULMO, the LUNGS, in ANATOMY. See there, nº 117.

PULMONARIA, LUNGWORT: A genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 41ſt order, *Aſperifoliæ*. The corolla is funnel-ſhaped, with its throat pervious; the calyx is priſmatic and pentagonal. There are ſeveral ſpecies; of which the moſt remarkable is the officinalis, common ſpotted lungwort, or Jeruſalem cowſlip. This is a native of woods and ſhady places in Italy and Germany, but has been cultivated in Britain for medicinal uſe. The leaves are of a green colour, ſpotted with white; and of a mucilaginous taſte, without any ſmell. They are recommended in phthiſis, ulcers of the lungs, &c. but their virtues in theſe diſeaſes are not warranted by experience.

PULO PINANG. See *PRINCE of Wales's Iſland*.

PULP, in pharmacy, the fleſhy and ſucculent parts of fruits extracted by infuſion or boiling, and paſſed through a ſieve.

PULPIT, an elevated place in a church, whence ſermons are delivered. The French give the ſame name to a reading-deſk.

PULPITUM, in the Grecian and Roman theatres, was a place where the players performed their parts. It was lower than the ſcena, and higher than the orcheſtra. It nearly anſwered to what we call the ſtage, as diſtinguiſhed from the pit and galleries.—*Pulpitum* was alſo a moveable deſk or pulpit, from which diſputants pronounced their diſſertations, and authors recited their works.

PULSE, in the animal economy, denotes the beating or throbbing of the heart and arteries.

No doctrine has been involved in more difficulties than that of pulſes; ſince, in giving a phyſiological account of them, phyſicians have eſpouſed quite oppoſite ſentiments; whilſt ſome doubt whether the pulſe is owing to the ſyſtole or diaſtole; as alſo, whether the motion of the heart and arteries is one and the ſame, for a moment of time.

With regard to motion, the pulſes are reckoned only four; great and little, quick and ſlow. When quickneſs and greatneſs are joined together, it becomes violent; and when it is little and ſlow it is called a *weak pulſe*. They are alſo ſaid to be *frequent* and *rare*, *equal* and *unequal*; but theſe are not the eſſential affections of motion. Frequency and quickneſs are often confounded with each other. A pulſe is ſaid to be *hard* or *ſoft*, with regard to the artery, according as it is tenſe, renitent, and hard, or flaccid, ſoft and lax: for the diſpoſition of the arteries contributes greatly to the change of the pulſe; wherefore it ſometimes happens, that the pulſe in both arms is not alike which is very common in a hemiplexy. Add to theſe a convulſive pulſe, which does not proceed from the blood, but from the ſtate of the artery; and is known by a tremulous ſubſultory motion, and the artery ſeems to be drawn upwards: this, in acute fevers, is the ſign of death; and is ſaid to be the pulſe in dying perſons, which is likewiſe generally unequal and intermitting. A *great* pulſe ſhows a more copious afflux of the blood to the heart, and from thence into the arteries; a *little* pulſe the contrary.

The pulſes of perſons differ according to the largeneſs of the heart and veſſels, the quantity and temperies of the blood, the elaſtic force of the canals; as alſo with regard to the ſex, age, ſeaſon, air, motion, food, ſleep, watchings, and paſſions of the mind. The pulſe is larger and more quick in men than in women; in the bilious and ſanguineo-bilious, than in the phlegmatic and melancholic. Thoſe who are lean, with tenſe fibres and large veſſels, have a greater and a ſtronger pulſe, than thoſe that are obeſe, with lax fibres and ſmall veſſels; whence they are more healthy, robuſt, and apt for labour. In children, the pulſe is quick and ſoft; in adults greater and more violent. In the old, it is commmonly great, hard, and ſlow. Labour, motion, and exerciſe of the body, increaſe the circulation of the blood, the excretions, and particularly reſpiration; reſt renders the circulation ſlow and weak; intenſe ſpeaking increaſes the circulation, and conſequently renders the pulſe large and quick. In watching, the pulſe is more evident; in ſleep, more ſlow and languid. After drinking hot things, ſuch as coffee and tea, or hot bath-waters, as well as after meals, the pulſe vibrates more quick. But nothing produces a greater change in the pulſe than affections of the mind: in terror, it is unequal, ſmall, and contracted; in joy, frequent and great; in anger, quick and hard; in ſadneſs, ſlow, ſmall, deep, and weak; and in intenſe ſtudy, languid and weak. With regard to the air, when, after the predominancy of a weſt or ſouth wind, it becomes north or eaſt, the pulſe is ſtronger and larger; as alſo when the quickſilver riſes in the barometer. But when the atmoſphere is denſe, humid, rainy, with a long ſouth wind; as alſo where the life is ſedentary, the ſleep long, and the ſeaſon autumnal, the pulſe is languid and ſmall, and the perſpiration decreaſed. In May it is great ſometimes and violent; in the middle of ſummer, quick but weak; in the autumn, ſlow, ſoft, and weak; in the winter, hard and great. A draſtic purge and an emetic render the pulſe hard, quick, and weak, with loſs of ſtrength; chalybeates, and the bark, render it great and robuſt, and the complexion lively; volatiles amplify and increaſe the pulſe; acids and nitrous remedies refrigerate the body, and appeaſe the pulſe; opiates and the like render it ſmall and weak, and decreaſe the elaſticity of the ſolids; and poiſons render it ſmall, contracted, and hard. When the quantity of the blood is too great, bleeding raiſes the pulſe.

PULSE, is alſo uſed for the ſtroke with which any medium is affected by the motion of light, ſound, &c. through it.

Sir Iſaac Newton demonſtrates, that the velocities of the pulſes in an elaſtic fluid medium (whoſe elaſticity is proportionable to its denſity) are in a ratio compounded of half the ratio of the elaſtic force directly, and half the ratio of the denſity inverſely; ſo that in a medium whoſe elaſticity is equal to its denſity, all pulſes will be equally ſwiſt.

Pulse, in botany, a term applied to all thoſe grains or ſeeds which are gathered with the hand; in contradiſtinction to corn, &c. which are reaped, or mowed: or, It is the ſeed of the leguminous kind of plants, as beans, vetches, &c. but is by ſome uſed for artichokes, aſparagus, &c.

PULTENEY (William), the famous oppoſer of Sir Robert Walpole in parliament, and afterward earl of Bath, was deſcended from one of the moſt ancient families in the kingdom, and was born in 1682. Being well qualified in fortune, he early procured a ſeat in the houſe of commons, and diſtinguiſhed himſelf as a warm partiſan againſt Queen Anne's miniſtry; whoſe errors he had ſagacity to detect, and ſpirited eloquence to expoſe. When King George I. came to the throne, Mr Pulteney was made ſecretary at war, and ſoon after cofferer to the king's houſehold; but the good underſtanding between this gentleman and Sir Robert Walpole, who then acted as prime miniſter, was interrupted in 1725, on a ſuſpicion that Walpole was deſirous of extending the limits of prerogative, and of promoting the intereſts of Hanover, to the prejudice of thoſe of Britain. His oppoſition to Sir Robert was indeed carried to ſuch indiſcriminate lengths, that ſome have been of opinion he often acted againſt meaſures beneficial to the public, merely from perſonal motives. It would be impracticable here to trace his parliamentary conduct: ſo it muſt ſuffice to obſerve in general, that he became ſo obnoxious to the crown, that in 1731 the king called for the council-book, and with his own hand ſtruck out his name from the liſt of the privy-counſellors; a proceeding that only ſerved to inflame his reſentment and increaſe his popularity. Thus he ſtill continued to attack the miniſter with a ſeverity of eloquence and ſarcaſm that worſted every antagoniſt; ſo that Sir Robert was heard to declare, he dreaded that man's tongue more than another man's ſword. At length, when Walpole found the place of prime miniſter no longer tenable, and reſigned in 1741, among other promotions Mr Pulteney reſumed his place in the privy-council, and was created earl of Bath; a title purchaſed at the expence of that popularity which afterward he naturally enough affected to contemn. In 1760, toward the cloſe of the war, he publiſhed *A Letter to two Great Men*, recommending proper articles to be inſiſted on in a treaty of peace; which, though the writer was then unknown, was greatly applauded, and went through ſeveral impreſſions. He died in 1764; and as his only ſon died before him, the title became extinct.

PULVERIZATION, the art of pulverizing, or reducing a dry body into a fine powder; which is performed, in friable bodies, by pounding or beating them in a mortar, &c.; but to pulverize malleable ones, other methods muſt be taken. To pulverize lead, or tin, the method is this: Rub a round wooden box all over the inſide with chalk; pour a little of the melted metal nimbly into the box; when ſhutting the lid, and ſhaking the box briſkly, the metal will be reduced to powder.

PUMEX, the Pumice-stone, a ſubſtance frequently thrown out of volcanoes, though there are many which are never known to throw it out. It is very full of pores and bliſters; in conſequence of which it is ſpecifically very light, and reſembles the frothy ſlag produced in our iron furnaces. It is of two colours, black and white; the former being that which it has when thrown out of the volcano; the latter, as Cronſtedt conjectures, being perhaps faded and bleached. M. Magellan conſiders it rather as a volcanic ejection than a volcanic production; and deſcribes it as of a white, reddiſh-brown, grey, or black colour. It is of a rough and porous conſiſtence, being made up of ſlender fibres parallel to each other, and very light, ſo that it ſwims on water. It ſtrikes fire with ſteel, though with difficulty, and ſeems originally to have been an aſbeſtos decompoſed by the action of fire; but, on obſerving the appearance of that glaſſy ſlag produced in the iron-furnaces, which entirely reſembles the pumice-ſtone, and is produced from the calcareous fluxes uſed to promote the fuſion of the ore, our author is of opinion that the formation of pumice may be rather attributed to that kind of froth which muſt be formed at the top of the melted matters in the volcanic crater. An hundred parts, according to Bergman, contain from 6 to 15 of magneſia, with a ſmall proportion of calcareous earth, and the greateſt part ſilex. Another kind of pumice, which ſeems to be a ferruginous granite altered by fire, has been diſcovered by Dolomieu at Stromboli.

Pumice-ſtone is uſed in ſome mechanical arts; as for rubbing and ſmoothing the ſurface of metals, wood, paſteboard, and ſtone; for which it is well fitted by reaſon of its harſh and brittle texture; thus ſcouring and carrying off the little inequalities from the ſurfaces juſt mentioned,

PUMICE-stone. See the preceding article.

PUMP, an hydraulic machine for raiſing water by means of the preſſure of the atmoſphere.

1 Of the invention of pumps.

It would be an entertaining and not an uninſtructive piece of information to learn the progreſſive ſteps by which the ingenuity of man has invented the various methods of raiſing water. A pump muſt be conſidered as the laſt ſtep of this progreſs. Common as it is, and overlooked even by the curious, it is a very abſtruſe and refined invention. Nothing like it has been found in any of the rude nations whom the reſtleſs ſpirit of the Europeans has diſcovered, either in the new continent of America or the iſlands of the Pacific Ocean. Nay, it was unknown in the cultivated empire of China at the time of our arrival there by ſea; and it is ſtill a rarity everywhere in Aſia, in places unfrequented by the Europeans. It does not appear to have been known to the Greeks and Romans in early times; and perhaps it came from Alexandria, where phyſical and mathematical ſcience was much cultivated by the Greek ſchool under the protection of the Ptolemies. The performances of Cteſibius and Hero are ſpoken of by Pliny and Vitruvius as curious novelties.

ties (A). It is perhaps not difficult to trace the ſteps by which thoſe mechanicians were led to the invention. The Egyptian wheel was a common machine all over Aſia, and is ſtill in uſe in the remoteſt corners, and was brought by the Saracens into Spain, where it is ſtill very common under its ancient name NORIA. The Daniſh miſſionaries found in a remote village in the kingdom of Siam the immediate offspring of the noria (*Lettres Edifiantes et Curieuſes.*) It was a wheel turned by an aſs, and carrying round, not a ſtring of earthen pots, but a ſtring of wiſps of hay, which it drew through a wooden trunk. This rude chain-pump was in frequent uſe for watering the rice fields. It is highly probable that it is of great antiquity, although we do not recollect its being mentioned by any of the Greek or Roman writers. The Arabs and Indians were nothing leſs than innovators; and we may ſuppoſe with great ſafety, that what arts we now find among them they poſſeſſed in very remote periods. Now the ſtep from this to the pump is but ſhort, though it is nice and refined; and the forcing pump of Cteſibius is the eaſieſt and moſt natural.

Plate cccxxiv. 2 Cteſibius's pump. Let AB (fig. 1.) be the ſurface of the water in the well, and D the height where it is to be delivered. Let DC be a long wooden trunk, reaching as deep under water as poſſible. Let the rope EF be fitted with its knot of hay F. When it is drawn up through the trunk, it will bring up along with it all the water lying between C and A, which will begin to run out by the ſpout D as ſoon as the knot gets to G, as far below D as C is below A. All this is very obvious; and it required but little reflection to be aſſured, that if F was let down again, or puſhed down, by a rod inſtead of a rope, it would again perform the ſame office. Here is a very ſimple pump. And if it was ever put in practice, it behoved to ſhow the ſupporting power of the atmoſphere, becauſe the water would not only be lifted by the knot, but would even follow it. The imperfection of this pump behoved to appear at firſt ſight, and to ſuggeſt its remedy. By puſhing down the knot F, which we ſhall henceforward call the *piſton*, all the force expended in lifting up the water between A and G is thrown away, becauſe it is again let down. A valve G, at the bottom, would prevent this. But then there muſt be a paſſage made for the water by a lateral tube KBD (fig. 2.) And if this be alſo furniſhed with a valve H, to prevent its loſing the water, we have the pump of Cteſibius, as ſketched in fig. 2. The valve is the great refinement: but perhaps even this had made its appearance before in the noria. For, in the more perfect kinds of theſe machines, the pots have a ſtop or valve in their bottom, which hangs open while the pot deſcends with its mouth downwards, and then allows it to fill readily in the ciſtern; whereas, without the valve, it would occaſion a double load to the wheel. If we ſuppoſe that the valve had made its appearance ſo early, it is not improbable that the common pump ſketched in fig. 3. was as old as that of Cteſibius. For a further deſcription of the pump of Cteſibius as it was uſed by the ancients, and of thoſe pumps which have been deduced from it and are now in common uſe, ſee HYDROSTATICS n° 28—32. In this place we ſhall firſt give a ſhort deſcription of the chief varieties of theſe engines, conſidering them in their ſimpleſt form, and we ſhall explain in very general terms their mode of operation. We ſhall then give a conciſe and popular theory of their operation, furniſhing principles to direct us in their conſtruction; and we ſhall conclude with the deſcription of a few peculiarities which may contribute to their improvement or perfection.

There are but two ſorts of pumps which eſſentially differ; and all the varieties that we ſee are only modifications of theſe. One of theſe original pumps has a ſolid piſton; the other has a piſton with a perforation and a valve. We uſually call the firſt a FORCING PUMP, and the ſecond a LIFTING or SUCKING PUMP.

3 Forcing pump deſcribed. Fig. 2. is a ſketch of the forcing pump in its moſt ſimple form and ſituation. It conſiſts of a hollow cylinder AC*ca*, called the WORKING BARREL, open at both ends, and having a valve G at the bottom, opening upwards. This cylinder is filled by a ſolid piſton EF, covered externally with leather or tow, by which means it fits the box of the cylinder exactly, and allows no water to eſcape by its ſides. There is a pipe KHD, which communicates laterally with this cylinder, and has a valve at ſome convenient place H, as near as poſſible to its junction with the cylinder. This valve alſo opens upwards. This pipe, uſually called the RISING PIPE, or MAIN, terminates at the place D, where the water muſt be delivered.

4 Its mode of operation. Now ſuppoſe this apparatus ſet into the water, ſo that the upper end of the cylinder may be under or even with the ſurface of the water AB; the water will open the valve G, and after filling the barrel and lateral pipe, will alſo open the valve H, and at laſt ſtand at an equal height within and without. Now let the piſton be put in at the top of the working barrel, and thruſt down to K. It will puſh the water before it. This will ſhut the valve G, and the water will make its way through the valve H, and fill a part B*b* of the riſing pipe, equal to the internal capacity of the working barrel. When this downward motion of the piſton ceaſes, the valve H will fall down by its own weight and ſhut this paſſage. Now let the piſton be drawn up again: The valve H hinders the water in the

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(A) In the early Greek writings, it does not appear that the words 'αντλος, 'αντλεῖν, 'αντλια, &c. were uſed to expreſs any thing like what we call a pump. In all theſe paſſages the words either expreſs generally the drawing of water, or, more particularly, the drawing it with a bucket or ſomething ſimilar. 'Αντλος, which is the primitive, is a drain, ſink, or receptacle for collecting ſcattered water, either for uſe, or to get rid of it; hence it came to ſignify the ſink or well of a ſhip; and 'αντλεῖν was ſynonymous with our verb "to bale the boat." (*Odyſſ.* O. 476. M. 411. *Euryp. Hecuba*, 1025). 'Αντλιον is the *veſſel* or *bucket* with which water is drawn. 'Αντλια is the ſervice (generally a puniſhment) of drawing water. 'Αντλεῖν, "to draw water with a bucket": hence the force of Ariſtotle's expreſſion (*Oecon.* 1). τω γαρ 'ηθμῷ αντλειν τουτ' ἐςι. See even the late authority of the New Teſtament, John ii. 8.; iv. 7. 11. Here 'αντλημα is evidently ſomething which the woman brought along with her; probably a bucket and rope.

the riſing pipe from returning into the working barrel. But now the valve G is opened by the preſſure of the external water, and the water enters and fills the cylinder as the piſton riſes. When the piſton has got to the top, let it be thruſt down again: The valve G will again be ſhut, and the water will be forced through the paſſage at H, and riſe along the main, puſhing before it the water already there, and will now have its ſurface at L. Repeating this operation, the water muſt at laſt arrive at D, however remote, and the next ſtroke would raiſe it to *e*; ſo that during the next riſe of the piſton the water in *e* D will be running off by the ſpout.

The effect will be the ſame whatever is the poſition of the working barrel, provided only that it be under water. It may lie horizontally or ſloping, or it may be with its mouth and piſton rod undermoſt. It is ſtill the ſame forcing pump, and operates in the ſame manner, and by the ſame means, viz. the preſſure of the ſurrounding water.

The external force which muſt be applied to produce this effect is oppoſed by the preſſure exerted by the water on the oppoſite face of the piſton. It is evident, from the common laws of hydroſtatics, that this oppoſing preſſure is equal to the weight of a pillar of water, having the face of the piſton for its baſe, and the perpendicular height *d* A of the place of delivery above the ſurface of the water AB in the ciſtern for its height. The form and dimenſions of the riſing pipe are indifferent in this reſpect, becauſe heavy fluids preſs only in the proportion of their perpendicular height. Obſerve that it is not *d* F, but *d* A, which meaſures this preſſure, which the moving force muſt balance and ſurmount. The whole preſſure on the under ſurface F *f* of the piſton is indeed equal to the weight of the pillar *d* F *f* δ; but part of this is balanced by the water AF *f a*. If indeed the water does not get into the upper part of the working barrel, this compenſation does not obtain. While we draw up the piſton, this preſſure is removed, becauſe all communication is cut off by the valve H, which now bears the whole preſſure of the water in the main. Nay, the aſcent of the piſton is even aſſiſted by the preſſure of the ſurrounding water. It is only during the deſcent of the piſton therefore that the external force is neceſſary.

Obſerve that the meaſure now given of the external force is only what is neceſſary for *balancing* the preſſure of the water in the riſing pipe. But in order that the pump may perform work, it muſt *ſurmount* this preſſure, and cauſe the water to iſſue at D with ſuch a velocity that the required quantity of water may be delivered in a given time. This requires force, even although there were no oppoſing preſſure; which would be the caſe if the main were horizontal. The water fills it, but it is at reſt. In order that a gallon, for inſtance, may be delivered in a ſecond, the whole water in the horizontal main muſt be put in motion with a certain velocity. This requires force. We muſt therefore always diſtinguiſh between the ſtate of equilibrium and the ſtate of actual working. It is the equilibrium only that we conſider at preſent: and no more is neceſſary for underſtanding the operation of the different ſpecies of pumps. The other force is of much more intricate inveſtigation, and will be conſidered by itſelf.

5 Lifting pump.

The ſimpleſt form and ſituation of the lifting pump is repreſented by the ſketch fig. 3. The pump is immerſed in the ciſtern till both the valve G and piſton F are under the ſurface AB of the ſurrounding water. By this means the water enters the pump, opening both valves, and finally ſtands on a level within and without.

6 Its mode of operating.

Now draw up the piſton to the ſurface A. It muſt lift up the water which is above it (becauſe the valve in the piſton remains ſhut by its own weight); ſo that its ſurface will now be at *a*, A *a* being made equal to AF. In the mean time the preſſure of the ſurrounding water forces it into the working barrel, through the valve G; and the barrel is now filled with water. Now, let the piſton be puſhed down again; the valve G immediately ſhuts by its own weight, and in oppoſition to the endeavours which the water in the barrel makes to eſcape this way. This attempt to compreſs the water in the barrel cauſes it to open the valve F in the piſton; or rather, this valve yields to our endeavour to puſh the piſton down through the water in the working barrel. By this means we get the piſton to the bottom of the barrel; and it has now above it the whole pillar of water reaching to the height *a*. Drawing up the piſton to the ſurface A a ſecond time, muſt lift this double column along with it, and its ſurface now will be at *b*. The piſton may again be thruſt down through the water in the barrel, and again drawn up to the ſurface which will raiſe the water to *c*. Another repetition will raiſe it to *d*; and it will now ſhow itſelf at the intended place of delivery. Another repetition will raiſe it to *e*; and while the piſton is now deſcending to make another ſtroke, the water in *ed* will be running off through the ſpout D; and thus a ſtream will be produced, in ſome degree continual, but very unequal. This is inconvenient in many caſes: thus, in a pump for domeſtic uſes, ſuch a hobbling ſtream would make it very troubleſome to fill a bucket. It is therefore uſual to terminate the main by a ciſtern LMNO, and to make the ſpout ſmall. By this means the water brought up by the ſucceſſive ſtrokes of the piſton riſes to ſuch a height in this ciſtern, as to produce an efflux by the ſpout nearly equable. The ſmaller we make the ſpout D the more equable will be the ſtream; for when the piſton brings up more water than can be diſcharged during its deſcent, ſome of it remains in the ciſtern. This, added to the ſupply of next ſtroke, makes the water riſe higher in the ciſtern than it did by the preceding ſtroke. This will cauſe the efflux to be quicker during its deſcent of the piſton, but perhaps not yet ſufficiently quick to diſcharge the whole ſupply. It therefore riſes higher next ſtroke; and at laſt it riſes ſo high that the increaſed velocity of efflux makes the diſcharge preciſely balance the ſupply. Now, the quantity ſupplied in each ſtroke is the ſame, and occupies the ſame room in the ciſtern at top; and the ſurface will ſink the ſame number of inches during the deſcent of the piſton, whether that ſurface has been high or low at the beginning. But becauſe the velocities of the efflux are as the ſquare roots of the heights of the water above the ſpout, it is evident that a ſink of two or three inches will make a ſmaller change in the velocity of efflux when this height and velocity are great. This ſeems but a trifling obſervation; but it ſerves to illuſtrate a thing to be conſidered afterwards, which is important and abſtruſe, but perfectly ſimilar to this.

It is evident, that the force neceſſary for this operation muſt be equal to the weight of the pillar of water *d* A *a* D, if the pipe be perpendicular. If the pump be ſtanding aſlope, the preſſure which is to be balanced is ſtill equal to the weight of a pillar of water of this perpendicular height, and having the ſurface of the piſton for its baſe.

Such is the ſimpleſt, and, we may add, by far the beſt, form of the forcing and lifting pumps; but it is not the moſt uſual. Circumſtances of convenience, economy, and more frequently of fancy and habit, have cauſed the pump-makers to deviate greatly from this form. It is not uſual to have the working barrel in the water; this, eſpecially in deep wells, makes it of difficult acceſs for repairs, and requires long piſton rods. This would not do in a forcing pump, becauſe they would bend.

7 Effect of giving the piſton a longer ſtroke.

We have ſuppoſed, in our account of the lifting pump, that the riſe of the piſton always terminated at the ſurface of the water in the ciſtern. This we did in order that the barrel might always be filled by the preſſure of the ſurrounding water. But let us ſuppoſe that the riſe of the piſton does not end here, and that it is gradually drawn up to the very top: it is plain that the preſſure of the atmoſphere is by this means taken off from the water in the pipe (ſee PNEUMATICS), while it remains preſſing on the water of the ciſtern. It will therefore cauſe the water to follow the piſton as it riſes through the pipe, and it will raiſe it in this way 33 feet at a medium. If, therefore, the ſpout D is not more than 33 feet above the ſurface of the water in the ciſtern, the pipe will be full of water when the piſton is at D. Let it be puſhed down to the bottom; the water will remain in the pipe, becauſe the valve G will ſhut: and thus we may give the piſton a ſtroke of any length not exceeding 33 feet. If we raiſe it higher than this, the water will not follow; but it will remain in the pipe, to be lifted by the piſton, after it has been puſhed down through it to the bottom.

8 Inconvenient and unneceſſary.

But it is not neceſſary, and would be very inconvenient, to give the piſton ſo long a ſtroke. The great uſe of a pump is to render effectual the reciprocation of a ſhort ſtroke which we can command, while ſuch a long ſtroke is generally out of our power. Suppoſe that the piſton is puſhed down only to *b*; it will then have a column *bf* incumbent on it, and it will lift this column when again drawn up. And this operation may be repeated like the former, when the piſton was always under water; for the preſſure of the atmoſphere will always cauſe the water to follow the piſton to the height of 33 feet.

Nor is it neceſſary that the fixed valve G be placed at the lower orifice of the pipe, nor even under water. For, while things are in the ſtate now deſcribed, the piſton drawn up to *f*, and the whole pipe full of water; if we ſuppoſe another valve placed at *b* above the ſurface of the ciſtern, this valve can do no harm. Now let the piſton deſcend, both valves G and *b* will ſhut. G may now be removed, and the water will remain ſupported in the ſpace *b* G by the air; and now the alternate motions of the piſton will produce the ſame effect as before.

9 Effect of the weight of the water and preſſure of the atmoſphere.

We found in the former caſe that the piſton was carrying a load equal to the weight of a pillar of water of the height AD, becauſe the ſurrounding water could only ſupport it at its own level. Let us ſee what change is produced by the aſſiſtance of the preſſure of the atmoſphere. Let the under ſurface of the piſton be at *b*; when the piſton was at *f*, 33 feet above the ſurface of the ciſtern, the water was raiſed to that height by the preſſure of the atmoſphere. Suppoſe a partition made at *b* by a thin plate, and all the water above it taken away. Now pierce a hole in this plate. The preſſure of the atmoſphere was able to carry the whole column *fa*. Part of this column is now removed, and the remainder is not a balance for the air's preſſure. This will therefore cauſe the water to ſpout up through this hole and riſe to *f*. Therefore the under ſurface of this plate is preſſed up by the contiguous water with a force equal to the weight of that pillar of water which it formerly ſupported; that is, with a force equal to the weight of the pillar *fb*. Now, the under ſurface of the piſton, when at *b*, is in the ſame ſituation. It is preſſed upwards by the water below it, with a force equal to the weight of the column *fb*: But it is preſſed downwards by the whole preſſure of the atmoſphere, which preſſes on all bodies; that is, with the weight of the pillar *fa*. On the whole, therefore, it is preſſed downwards by a force equal to the difference of the weights of the pillars *fa* and *fb*; that is, by a force equal to the weight of the pillar *ba*.

It may be conceived better perhaps in this way. When the piſton was under the ſurface of the water in the ciſtern, it was equally preſſed on both ſides, both by the water and atmoſphere. The atmoſphere exerted its preſſure on it by the intervention of the water; which being, to all ſenſe, a perfect fluid, propagates every external preſſure undiminiſhed. When the piſton is drawn up above the ſurface of the pit-water, the atmoſphere continues to preſs on its upper ſurface with its whole weight, through the intervention of the water which lies above it; and its preſſure muſt therefore be added to that of the incumbent water. It alſo continues to preſs on the under ſurface of the piſton by the intervention of the water; that is, it preſſes this water to the piſton. But, in doing this, it carries the weight of this water which it is preſſing on the piſton. The preſſure on the piſton therefore is only the exceſs of the whole preſſure of the atmoſphere above the weight of the column of water which it is ſupporting. Therefore the difference of atmoſpheric preſſure on the upper and under ſurfaces of the piſton is preciſely equal to the weight of the column of water ſupported in the pipe by the air. It is not, however, the individual weight of this column that loads the piſton; it is the part of the preſſure of the atmoſphere on its upper ſurface, which is not balanced by its preſſure on the under ſurface.

In attempting therefore to draw up the piſton, we have to ſurmount this unbalanced part of the preſſure of the atmoſphere, and alſo the weight of the water which lies above the piſton, and muſt be lifted by it: and thus the whole oppoſing preſſure is the ſame as before, namely, the weight of the whole vertical pillar reaching from the ſurface of the water in the ciſtern to the place of delivery. Part of this weight is immediately carried by the preſſure of the atmoſphere; but, in lieu of it, there is an equal part of this preſſure of the atmoſphere abſtracted from the under ſurface of the piſton, while its upper ſurface ſuſtains its whole preſſure.

10 Other circumſtances to be attended to.

So far, then, theſe two ſtates of the pump agree.— But they differ exceedingly in their mode of operation; and there are ſome circumſtances not very obvious which muſt be attended to, in order that the pump may deliver any water at the ſpout D. This requires, therefore, a ſerious examination.

Let the fixed valve G (fig. 4.) be ſuppoſed at the ſurface of the ciſtern water. Let M *m* be the loweſt, and N*n* the higheſt, poſitions of the piſton, and let $\text{HA}=h$ be the height of a column of water equiponderant with the atmoſphere.

When the pump is filled, not with water, but with air, and the piſton is in its loweſt poſiton, and all in equilibrio, the internal air has the ſame denſity and elaſticity with the external. The ſpace MA *a m*, therefore, contains air of the common denſity and elaſticity. Theſe may be meaſured by h, or the weight of a column of water whoſe height is h. Now, let the piſton be drawn up to N *n*. The air which occupied the ſpace MA *a m* now occupies the ſpace NA *a n*, and its denſity is now $\frac{\text{MA}\,am}{\text{NA}\,an}$. Its elaſticity is now diminiſhed, being proportionable to its denſity (ſee Pneumatics), and no longer balances the preſſure of the atmoſphere. The valve G will therefore be forced up by the water, which will riſe to ſome height SA. Now let the piſton again deſcend to M *m*. It cannot do this with its valve ſhut; for when it comes down ſo far as to reduce the air again to its common denſity, it is not yet at M, becauſe the ſpace below it has been diminiſhed by the water which got into the pipe, and is retained there by the valve G. The piſton valve, therefore, opens by the air which we thus attempt to compreſs, and the ſuperfluous air eſcapes. When the piſton has got to M, the air is again of the common denſity, and occupies the ſpace MS *s m*. Now draw the piſton up to N. This air will expand into the ſpace NS *sn*, and its denſity will be reduced to $\frac{\text{MS}\,sm}{\text{NS}\,sn}$, and its elaſticity will no longer balance the preſſure of the atmoſphere, and more water will enter, and it will riſe higher. This will go on continually. But it may happen that the water will never riſe ſo high as to reach the piſton, even though not 33 feet above the water in the ciſtern: For the ſucceſſive diminutions of denſity and elaſticity are a ſeries of quantities that decreaſe geometrically, and therefore will have a limit. Let us ſee what determines this limit.

At whatever height the water ſtands in the lower part of the pipe, the weight of the column of water SA *as*, together with the remaining elaſticity of the air above it, exactly balances the preſſure of the atmoſphere (ſee Pneumatics, nº 108.) Now the elaſticity of the air in the ſpace NS *s n* is equal to $h\times\frac{\text{MS}\,s\,m}{\text{NS}\,s\,n.}$ Therefore, in the caſe where the limit obtains, and the water riſes no farther, we muſt have $h=\text{AS}+h\frac{\text{MS}\,s\,m}{\text{NS}\,s\,n}$, or, becauſe the column is of the ſame diameter throughout, $h=\text{AS}+h\frac{\text{MS}}{\text{NS}}$ and $\frac{\text{MS}}{\text{NS}}h=h-\text{AS}$, $=\text{HS}$, and $\text{NS}:\text{MS}=\text{HA}:\text{HS}$, and $\text{NS}-\text{MS}:\text{NS}=\text{HA}-\text{HS}:\text{HA}$, or $\text{NM}:\text{NS}=\text{AS}:\text{AH}$, and $\text{NM}\times\text{AH}=\text{NS}\times\text{AS}$.— Therefore, if AN, the diſtance of the piſton in its higheſt poſition from the water in the ciſtern, and NM the length of its ſtroke, be given there is a certain determined height AS to which the water can be raiſed by the preſſure of the air: For AH is a conſtant quantity; and therefore when MN is given, the rectangle $\text{AS}\times\text{SN}$ is given. If this height AS be leſs than that of the piſton in its loweſt poſition, the pump will raiſe no water, although AN may be leſs than AH. Yet the ſame pump will raiſe water very effectually, if it be firſt of all filled with water; and we have ſeen profeſſional engineers much puzzled by this capricious failure of their pumps. A little knowledge of the principles would have prevented their diſappointment.

11 Mode of inſuring the delivery of water.

To inſure the delivery of water by the pump, the ſtroke muſt be ſuch that the rectangle $\text{MN}\times\text{AH}$ may be greater than any rectangle that can be made of the parts of AN, that is, greater than the ſquare of half AN. Or, if the length of the ſtroke be already fixed by other circumſtances, which is a common caſe, we muſt make AN ſo ſhort that the ſquare of its half, meaſured in feet, ſhall be leſs than 33 times the ſtroke of the piſton.

Suppoſe that the fixed valve, inſtead of being at the ſurface of the water in the ciſtern, is at S, or any where between S and A, the performance of the pump will be the ſame as before: But if it be placed any where above S, it will be very different. Let it be at T. It is plain that when the piſton is puſhed down from N to M, the valve at T prevents any air from getting down; and therefore, when the piſton is drawn up again, the air contained in the ſpace MT *t m* will expand into the ſpace NT *tn*, and its denſity will be $\frac{\text{MT}}{\text{NT}}$. This is leſs than $\frac{\text{MS}}{\text{NS}}$, which expreſſes the denſity of the air which was left in the ſpace TS *st* by the former operations.— The air, therefore in TS *s t* will alſo expand, will open the vale, and now the water will riſe above S. The proportion of NS to NT may evidently be ſuch that the water will even get above the valve T. This diminiſhes the ſpace NT *t n*; and therefore, when the piſton has been puſhed down to M, and again drawn up to N, the air will be ſtill more rarefied, and the water will riſe ſtill higher. The foregoing reaſoning, however, is ſufficient to ſhow that there may ſtill be a height which the water will not paſs, and that this height depends on the proportion between the ſtroke of the piſton and its diſtance from the water in the ciſtern. We need not give the determination, becauſe it will come in afterwards in combination with other circumſtances. It is enough that the reader ſees the phyſical cauſes of this limitation: And, laſtly, we ſee plainly that the utmoſt ſecurity will be given for the performance of the pump, when the fixed valve is ſo placed that the piſton, when in its loweſt poſition, ſhall come into contact with it. In this caſe, the rarefaction of the air will be the completeſt poſſible; and, if there were no ſpace left between the piſton and valve, and all were perfectly air-tight, the rarefaction would be complete, and the valve might be any thing leſs than 33 feet from the ſurface of the water in the ciſtern.

12 Valves no eaſily kep air-tight.

But this perfect contact and tightneſs is unattainable; and though the pump may be full of water, its continual downward preſſure cauſes it to filtrate ſlowly through every crevice, and the air enters through every pore, and even diſengages itſelf from the water, with which a conſiderable portion had been chemically combined. The pump by this means loſes water, and it requires ſeveral ſtrokes of briſk working to fill it again:

and if the leathers have become dry, ſo much admiſſion may be given to the air, that the pump will not fill itſelf with water by *any working*. It is then neceſſary to pour water into it, which ſhuts up theſe paſſages, and ſoon ſets all to rights again. For theſe reaſons, it is always prudent to place the fixed valve as low as other circumſtances will permit, and to make the piſton rod of ſuch a length, that when it is at the bottom of its ſtroke it ſhall be almoſt in contact with the valve. When we are not limited by other circumſtances, it is evident that the beſt poſſible form is to have both the piſton and the fixed valve under the ſurface of the water of the ciſtern. In this ſituation they are always wet and air-tight. The chief objection is, that by this diſpoſition they are not eaſily come at when needing repair. This is a material objection in deep mines. In ſuch ſituations, therefore, we muſt make the beſt compenſation of different circumſtances that we can. It is uſual to place the fixed valve at a moderate diſtance from the ſurface of the water, and to have a hole in the ſide of the pipe, by which it may be got out. This is carefully ſhut up by a plate firmly ſcrewed on, with leather or cement between the parts. This is called the *clack door*. It would, in every caſe, be very proper to have a fixed valve in the lower end of the pipe. This would combine all advantages. Being always tight, the pipe would retain the water, and it would leave to the valve above it its full effect of increaſing the rarefaction. A ſimilar hole is made in the working barrel, a little above the higheſt poſition of the piſton. When this needs repair, it can be got at through this hole, without the immenſe trouble of drawing up the whole rods.

Thus we have conducted the reader ſtep by ſtep, from the ſimpleſt form of the pump to that which long experience has at laſt ſelected as the moſt generally convenient. This we ſhall now deſcribe in ſome detail.

13
Deſcription of the ſucking-pump.

The Sucking Pump conſiſts of two pipes DCCD, BAAB (fig. 5.); of which the former is called the *Barrel*, or the *Working Barrel*, and the other is called the *Suction-pipe*, and is commonly of a ſmaller diameter.—Theſe are joined by means of ſtanches E, F, pierced with holes to receive ſcrewed bolts. A ring of leather, or of lead, covered with a proper cement, is put between them; which, being ſtrongly compreſſed by the ſcrew-bolts, renders the joint perfectly air-tight.—The lower end A of the ſuction-pipe is commonly ſpread out a little to facilitate the entry of the water, and frequently has a grating acroſs it at AA to keep out filth or gravel. This is immerged in the ſtanding water YZ. The working barrel is cylindrical, as evenly and ſmoothly bored as poſſible, that the piſton may fill it exactly through its whole length, and move along it with as little friction as may be conſiſtent with air-tightneſs.

The piſton is a ſort of truncated cone OPKL, generally made of wood not apt to ſplit, ſuch as elm or beech. The ſmall end of it is cut off at the ſides, ſo as to form a ſort of arch OQP, by which it is faſtened to the iron rod or ſpear. It is exhibited in different poſitions in figures 6, 7. which will give a more diſtinct notion of it than any deſcription. The two ends of the conical part may be hooped with braſs. This cone has its larger end ſurrounded with a ring or band of ſtrong leather faſtened with nails, or by a copper hoop, which is driven on it at the ſmaller end. This band ſhould reach to ſome diſtance beyond the baſe of the cone; the farther the better: and the whole muſt be of uniform thickneſs all round, ſo as to ſuffer equal compreſſion between the cone and the working barrel.

14
Neceſſity of air tightneſs not properly attended to.

The ſeam or joint of the two ends of this band muſt be made very cloſe, but not ſewed or ſtitched together. This would occaſion bumps or inequalities, which would ſpoil its tightneſs; and no harm can reſult from the want of it, becauſe the two edges will be ſqueezed cloſe together by the compreſſion in the barrel. It is by no means neceſſary that this compreſſion be great. This is a very detrimental error of the pump-makers. It occaſions enormous friction, and deſtroys the very purpoſe which they have in view, viz. rendering the piſton air-tight; for it cauſes the leather to wear through very ſoon at the edge of the cone, and it alſo wears the working barrel. This very ſoon becomes wide in that part which is continually paſſed over by the piſton, while the mouth remains of its original diameter, and it becomes impoſſible to thruſt in a piſton which ſhall completely fill the worn part.

15
An eaſy mode of rendering pumps tight.

Now, a very moderate preſſure is ſufficient for rendering the pump perfectly tight, and a piece of glove leather would be ſufficient for this purpoſe, if looſe or detached from the ſolid cone; for ſuppoſe ſuch a looſe and flexible, but impervious, band of leather put round the piſton, and put into the barrel; and let it even be ſuppoſed that the cone does not compreſs it in the ſmalleſt degree to its internal ſurface.—Pour a little water carefully into the inſide of this ſort of cup or diſh; it will cauſe it to ſwell out a little, and apply itſelf cloſe to the barrel all round, and even adjuſt itſelf to all its inequalities. Let us ſuppoſe it to touch the barrel in a ring of an inch broad all round. We can eaſily complete the force with which it is preſſed. It is half the weight of a ring of water an inch deep and an inch broad. This is a trifle, and the friction occaſioned by it not worth regarding; yet this trifling preſſure is ſufficient to make the paſſage perfectly impervious, even by the moſt enormous preſſure of a high column of incumbent water; for let this preſſure be ever ſo great, the preſſure by which the leather adheres to the barrel always exceeds it, becauſe the incumbent fluid has no *preponderating* power by which it can force its way between them, and it muſt inſinuate itſelf preciſely ſo far, that its preſſure on the inſide of the leather ſhall ſtill exceed, and only exceed, the preſſure by which it endeavours to inſinuate itſelf; and thus the piſton becomes perfectly tight with the ſmalleſt poſſible friction. This reaſoning is perhaps too refined for the uninſtructed artiſt, and probably will not perſuade him.

16
Proved to be practicable from the human frame.

To ſuch we could recommend an examination of the piſtons and valves contrived and executed by that artiſt, whoſe ſkill far ſurpaſſes our higheſt conceptions, the all-wiſe Creator of this world. The valves which ſhut up in the paſſages of the veins, and this in places where an extravaſation would be followed by inſtant death, are cups of thin membrane, which adhere to the ſides of the channel about half way round, and are detached in the reſt of their circumference. When the blood comes in the oppoſite direction, it puſhes the membrane aſide, and has a paſſage perfectly free. But a ſtagnation of motion allows the tone of the muſcular (perhaps) membrane, to reſtore it to its natural ſhape, and the leaſt *motion* in the oppoſite direction cauſes it inſtantly to clap cloſe to the ſides of the vein, and then no preſſure whatever can force a paſſage. We ſhall recur

17 Beſt form of a piſton recommended.

to this again, when deſcribing the various contrivances of valves, &c. What we have ſaid is enough for ſupporting our directions for conſtructing a tight piſton. But we recommended thick and ſtrong leather, while our preſent reaſoning ſeems to render thin leather preferable. If the leather be thin, and the ſolid piſton in any part does not preſs it gently to the barrel, there will be in this part an unbalanced preſſure of the incumbent column of water, which would inſtantly burſt even a ſtrong leather bag; but when the ſolid piſton, covered with leather, exactly fills the barrel, and is even preſſed a little to it, there is no ſuch riſk; and now that part of the leather band which reaches beyond the ſolid piſton performs its office in the completeſt manner. We do not heſitate, therefore, to recommend this form of a piſton, which is the moſt common and ſimple of all, as preferable, when well executed, to any of thoſe more artificial, and frequently very ingenious, conſtructions, which we have met with in the works of the firſt engineers. To proceed, then, with our deſcription of the ſucking-pump.

18 Further deſcription of the ſucking-pump.

At the joining of the working barrel with the ſuction pipe there is a hole H, covered with a valve opening upwards. This hole H is either made in a plate which makes a part of the ſuction-pipe, being caſt along with it, or it is made in a ſeparate plate. This laſt is the moſt convenient, being eaſily removed and replaced. Different views are given of this valve in fig. 8, 9, 10. The diameter EF (fig. 10.) of this plate is the ſame with that of the flanches, and it has holes correſponding to them, through which their bolts paſs which keep all together. A ring of thick leather NKL is applied to this plate, having a part cut out between N and L, to make room for another piece of ſtrong leather NR (fig. 9.) which compoſes the valve. The circular part of this valve is broader than the hole in the middle of fig. 10. but not quite ſo broad as to fill up the inſide of the ring of leather OQP of this fig. which is the ſame with GKI of fig. 10. The middle of this leather valve is ſtrengthened by two braſs (not iron) plates, the uppermoſt of which is ſeen at R of fig. 9: the one on its underſide is a little ſmaller than the hole in the valve-plate, that it may go freely in; and the upper plate R is larger than this hole, that it may compreſs the leather to its brim all round. It is evident, that when this plate with its leathers is put between the joint flanches, and all is ſcrewed together, the tail of leather N of fig. 9. will be compreſſed between the plates, and form a hinge, on which the valve can turn, riſing and falling. There is a ſimilar valve faſtened to the upper ſide, or broadeſt baſe of the piſton. This deſcription ſerves for both valves, and in general for moſt valves which are to be found in any parts of a pump.

19 Its mode of operation.

The reader will now underſtand, without any repetition, the proceſs of the whole operation of a ſucking-pump. The piſton rarefies the air in the working barrel, and that in the ſuction-pipe expands thro' the valve into the barrel; and, being no longer a balance for the atmoſpheric preſſure, the water riſes into the ſuction-pipe; another ſtroke of the piſton produces a ſimilar effect, and the water riſes farther, but by a ſmaller ſtep than by the preceding ſtroke: by repeating the ſtrokes of the piſton, the water gets into the barrel; and when the piſton is now puſhed down through it, it gets above the piſton, and muſt now be lifted up to any height. The ſuction-pipe is commonly of ſmaller ſize than the working barrel, for the ſake of economy. It is not neceſſary that it be ſo wide: but it may be, and often is, made too ſmall. It ſhould be of ſuch a ſize, that the preſſure of the atmoſphere may be able to fill the barrel with water as faſt as the piſton riſes. If a void is left below the piſton, it is evident that the piſton muſt be carrying the whole weight of the atmoſphere, beſides the water which is lying above it. Nay, if the pipe be only ſo wide, that the barrel ſhall fill preciſely as faſt as the piſton riſes, it muſt ſuſtain all this preſſure. The ſuction-pipe ſhould be wider than this, that all the preſſure of the atmoſphere which exceeds the weight of the pillar in the ſuction-pipe may be employed in preſſing it on the under ſurface of the piſton, and thus diminiſh the load. It cannot be made too wide; and too ſtrict an economy in this reſpect may very ſenſibly diminiſh the performance of the pump, and more than defeat its own purpoſe. This is moſt likely when the ſuction-pipe is long, becauſe there the length of the pillar of water nearly balances the air's preſſure, and leaves very little accelerating force; ſo that water will riſe but ſlowly even in the wideſt pipe. All theſe things will be made the ſubjects of computation afterwards.

It is plain that there will be limitations to the riſe of the water in the ſuction-pipe, ſimilar to what we found when the whole pump was an uniform cylinder. Let a be the height of the fixed valve above the water in the ciſtern: let B and b be the ſpaces in cubic meaſure between this valve and the piſton in its higheſt and loweſt poſitions, and therefore expreſs the bulks of the air which may occupy theſe ſpaces: let y be the diſtance between the fixed valve and the water in the ſuction-pipe, when it has attained its greateſt height by the rarefaction of the air above it: let h be the height of a column of water in equilibrio, with the whole preſſure of the atmoſphere, and therefore having its weight in equilibrio with the elaſticity of common air: and let x be the height of the column whoſe weight balances the elaſticity of the air in the ſuction-pipe, when rarefied as much as it can be by the action of the piſton, the water ſtanding at the height $a-y$.

Then, becauſe this elaſticity, together with the column $a-y$ in the ſuction-pipe, muſt balance the whole preſſure of the atmoſphere, (ſee Pneumatics. n° 108.), we muſt have $h=x+a-y$, and $y=a+x-h$.

When the piſton was in its loweſt poſition, the bulk of the air between it and the fixed valve was b. Suppoſe the valve kept ſhut, and the piſton raiſed to its higheſt poſition, the bulk will be B, and its denſity $\frac{b}{B}$, and its elaſticity, or the height of the column whoſe weight will balance it, will be $h\frac{b}{B}$. If the air in the ſuction-pipe be denſer than this, and conſequently more elaſtic, it will lift the valve, and ſome will come in; therefore, when the pump has rarefied the air as much as it can, ſo that none does, in fact, come in, the elaſticity of the air in the ſuction-pipe *muſt* be the ſame.

Therefore $x=h\frac{b}{B}$.

We had $y = a + x - b$. Therefore $y = a + b\frac{b}{B} - b, = a + \frac{b-B}{B}b, = a - \frac{B-b}{B}b$.

Therefore when $\frac{B-b}{B}b$ is leſs than a, the water will ſtop before it reaches the fixed valve. But when a is leſs than $\frac{B-b}{B}b$, the water will get above the fixed valve, y becoming negative.

But it does not follow that the water will reach the piſton, that is, will riſe ſo high that the piſton will paſs through it in its deſcent. Things now come into the condition of a pump of uniform dimenſions from top to bottom; and this point will be determined by what was ſaid when treating of ſuch a pump.

20 The ſame pump is uſed in an inverted poſition;

There is another form of the ſucking pump which is much uſed in great water works, and is of equal efficacy with the one now deſcribed. It is indeed the ſame pump in an inverted poſition. It is repreſented in fig. 11. where ABCD is the working barrel, immerſed, with its mouth downwards, in the water of the ciſtern. It is joined by means of flatches to the riſing pipe or MAIN.

This uſually conſiſts of two parts. The firſt, BEFC, is bent to one ſide, that it may give room for the iron frames TXYV, which carries the rod NO of the piſton M, attached to the traverſes RS, TOV of this frame. The other part, EGHF, is uſually of a leſs diameter, and is continued to the place of delivery. The piſton frame XTVY hangs by the rod Z, at the arm of a lever or working beam, not brought into the figure. The piſton is perforated like the former, and is ſurrounded like it with a band of leather in form of a taper-diſh. It has a valve K on its broad or upper baſe, opening when preſſed from below. The upper end of the working barrel is pierced with a hole, covered with a valve I, alſo opening upwards.

Now ſuppoſe this apparatus immerſed into the ciſtern till the water is above it, as marked by the line 2, 3, and the piſton drawn up till it touch the end of the barrel. When the piſton is allowed to deſcend by its own weight, the water riſes up through its valve K, and fills the barrel. If the piſton be now drawn up by the moving power of the machinery with which it is connected, the valve K ſhuts, and the piſton puſhes the water before it through the valve I into the main pipe EFGH. When the piſton is again let down, the valve I ſhuts by its own weight and the preſſure of the water incumbent on it, and the barrel is again filled by the water of the ciſtern. Drawing up the piſton puſhes this water into the main pipe, &c. and then the water is at length delivered at the place required.

21 And is called a lifting pump.

This pump is uſually called the *lifting pump*; perhaps the ſimpleſt of all in its principle and operation.—It needs no farther explanation: and we proceed to deſcribe

22 Forcing-pump deſcribed.

The FORCING PUMP, repreſented in fig. 12. It conſiſts of a working barrel ABCD, a ſuction-pipe CDEF, and a main or riſing pipe. This laſt is uſually in three joints. The firſt GHKI may be conſidered as making part of the working barrel, and is commonly caſt in one piece with it. The ſecond IKLM is joined to it by flanches, and forms the elbow which this pipe muſt generally have. The third LNOM is properly the beginning of the main, and is continued to the place of delivery. At the joint IK there is a hanging valve or clack S; and there is a valve R on the top of the ſuction-pipe.

The piſton PQTV is ſolid, and is faſtened to a ſtout iron rod which goes through it, and is fixed by a key drawn through its end. The body of the piſton is a ſort of double cone, widening from the middle to each end, and is covered with two bands of very ſtrong leather, fitted to it in the manner already deſcribed.

23 Its mode of operation

The operation of this pump is abundantly ſimple. When the piſton is thruſt into the pump, it puſhes the air before it through the valve S, for the valve R remains ſhut by its own weight. When it has reached near the bottom, and is drawn up again, the air which filled the ſmall ſpace between the piſton and the valve S now expands into the barrel; for as ſoon as the air begins to expand, it ceaſes to balance the preſſure of the atmoſphere, which therefore ſhuts the valve S. By the expanſion of the air in the barrel the equilibrium at the valve R is deſtroyed, and the air in the ſuction-pipe lifts the valve, and expands into the barrel; conſequently it ceaſes to be a balance for the preſſure of the atmoſphere, and the water is forced into the ſuction-pipe. Puſhing the piſton down again forces the air in the barrel through the valve S, the valve R in the mean time ſhutting. When the piſton is again drawn up, S ſhuts, R opens, the air in the ſuction-pipe dilates anew, and the water riſes higher in it. Repeating theſe operations, the water gets at laſt into the working barrel, and is forced into the main by puſhing down the piſton, and is puſhed along to the place of delivery.

24 Is two-fold.

The operation of this pump is therefore two-fold, ſucking and forcing. In the firſt operation, the ſame force muſt be employed as in the ſucking-pump, namely, a force equal to the weight of a column of water having the ſection of the piſton for its baſe, and the height of the piſton above the water in the ciſtern for its height. It is for the ſake of this part of the operation that the upper cone is added to the piſton. The air and water would paſs by the ſides of the lower cone while the piſton is drawn up; but the leather of the upper cone applies to the ſarface of the barrel, and prevents this. The ſpace contained between the barrel and the valve S is a great obſtruction to this part of the operation, becauſe this air cannot be rarified to a very great degree. For this reaſon the ſuction-pipe of a forcing-pump muſt not be made long. It is not indeed neceſſary; for by placing the pump a few feet lower, the water will riſe into it without difficulty, and the labour of ſuction is as much diminiſhed as that of impulſion is increaſed. However, an intelligent artiſt will always endeavour to make this ſpace between the valve S and the loweſt place of the piſton as ſmall as poſſible.

The power employed in forcing muſt evidently ſurmount the preſſure of the whole water in the riſing pipe, and (independent of what is neceſſary for giving the water the required velocity, ſo that the proper quantity per hour may be delivered), the piſton has to withſtand a force equal to the weight of a column of water having the ſection of the piſton for its baſe, and the perpendicular altitude of the place of delivery above the lower ſurface of the piſton for its height. It is quite indifferent in this reſpect what is the diameter of the riſing pipe; becauſe the preſſure on the piſton depends on the altitude of the water only, independent of its quantity. We ſhall even ſee that a ſmall riſing pipe will require a greater force to convey the water along it to any given height or diſtance.

When we would employ a pump to raiſe water in a crooked pipe, or in any pipe of moderate dimenſions, this form of pump, or ſomething equivalent, muſt be uſed. In bringing up great quantities of water from mines, the common ſucking-pump is generally employed, as really the beſt of them all: but it is the moſt expenſive, becauſe it requires the pipe to be perpendicular, ſtraight, and of great dimenſions, that it may contain the piſton rods. But this is impracticable when the pipe is crooked.

If the forcing pump, conſtructed in the manner now deſcribed, be employed, we cannot uſe forces with long rods. Theſe would bend when puſhed down by their further extremity. In this caſe, it is uſual to employ only a ſhort and ſtiff rod, and to hang it by a chain, and load it with a weight ſuperior to the weight of water to be raiſed by it. The machinery therefore is employed, not in forcing the water along the riſing-pipe, but in raiſing the weight which is to produce this effect by its ſubſequent deſcent

In this caſe, it would be much better to employ the lifting-pump of fig. 11. For as the load on the forcers muſt be greater than the reſiſtances which it muſt ſurmount, the force exerted by the machine muſt in like manner be greater than this load. This double exceſs would be avoided by uſing the lifting-pump.

25 Meaſure of the quantity of water delivered by any pump.

It will readily occur to the reader that the quantity of water delivered by any pump will be in the joint proportion of the ſurface or baſe of the piſton and its velocity: for this meaſures the capacity of that part of the working barrel which the piſton paſſes over. The velocity of the water in the conduit pipe, and in its paſſage through every valve, will be greater or leſs than the velocity of the piſton in the ſame proportion that the area of the piſton or working-barrel is greater or leſs than the area of the conduit or valve. For whatever quantity of water paſſes through any ſection of the working-barrel in a ſecond, the ſame quantity muſt go through any one of theſe paſſages. This enables us to modify the velocity of the water as we pleaſe: we can increaſe it to any degree at the place of delivery by diminiſhing the aperture through which it paſſes, provided we apply ſufficient force to the piſton.

26 The operation of pumps not equable;

27 And the mode of making them ſo.

It is evident that the operation of a pump is by ſtarts, and that the water in the main remains at reſt, preſſing on the valve during the time that the piſton is withdrawn from the bottom of the working barrel. It is in moſt caſes deſirable to have this motion equable, and in ſome caſes it is abſolutely neceſſary. Thus, in the engine for extinguiſhing fires, the ſpout of water going by jerks could never be directed with a certain aim, and half of the water would be loſt by the way; becauſe a body at reſt cannot in an inſtant be put in rapid motion, and the firſt portion of every jerk of water would have but a ſmall velocity. A very ingenious contrivance has been fallen upon for obviating this inconvenience, and procuring a ſtream nearly equable. We have not been able to diſcover the author. At any convenient part of the riſing pipe beyond the valve S there is annexed a capacious veſſel VZ (fig. 13. n° 1 and 2.) cloſe atop, and of great ſtrength. When the water is forced along this pipe, part of it gets into this veſſel, keeping the air confined above it, and it fills it to ſuch a height V, that the elaſticity of the confined air balances a column reaching to T, we ſhall ſuppoſe, in the riſing pipe. The next ſtroke of the piſton ſends forward more water, which would fill the riſing pipe to ſome height above T. But the preſſure of this additional column cauſes ſome more of it to go into the air veſſel, and compreſs its air ſo much more that its elaſticity now balances a longer column. Every ſucceeding ſtroke of the piſton produces a like effect. The water riſes higher in the main pipe, but ſome more of it goes into the air-veſſel. At laſt the water *appears* at the place of delivery; and the air in the air-veſſel is now ſo much compreſſed that its elaſticity balances the preſſure of the whole column. The next ſtroke of the piſton ſends forward ſome more water. If the diameter of the orifice of the main be ſufficient to let the water flow out with a velocity equal to that of the piſton, it will ſo flow out, riſing no higher, and producing no ſenſible addition to the compreſſion in the air-veſſel. But if the orifice of the main be contracted to half its dimenſions, the water ſent forward by the piſton cannot flow out in the time of the ſtroke without a greater velocity, and therefore a greater force. Part of it, therefore, goes into the air-veſſel, and increaſes the compreſſion. When the piſton has ended its ſtroke, and no more water comes forward, the compreſſion of the air in the air-veſſel being greater than what was ſufficient to balance the preſſure of the water in the main pipe, now forces out ſome of the water which is lying below it. This cannot return towards the pump, becauſe the valve S is now ſhut. It therefore goes forward along the main, and produces an efflux during the time of the piſton's riſing in order to make another ſtroke. In order that this efflux may be very equable, the air-veſſel muſt be very large. If it be ſmall, the quantity of water that is diſcharged by it during the return of the piſton makes ſo great a portion of its capacity, that the elaſticity of the confined air is too much diminiſhed by this enlargement of its bulk, and the rate of efflux muſt diminiſh accordingly. The capacity of the air-veſſel ſhould be ſo great that the change of bulk of the compreſſed air during the inaction of the piſton may be inconſiderable. It muſt therefore be very ſtrong.

It is pretty indifferent in what way this air-veſſel is connected with the riſing pipe. It may join it laterally, as in fig. 13. n° 1. and the main pipe go on without interruption; or it may be made to *ſurround* an interruption of the main pipe, as in fig. 13. n° 2. It may alſo be in any part of the main-pipe. If the ſole effect intended by it is to produce an equable jet, as in ornamental water-works, it may be near the end of the main. This will require much leſs ſtrength, becauſe there remains but a ſhort column of water to compreſs the air in it. But it is, on the whole, more advantageous to place it as near the pump as poſſible, that it may produce an equable motion in the whole main-pipe. This is of conſiderable advantage: when a column of water ſeveral hundred feet long is at reſt in the main-pipe, and the piſton at one end of it put at once into motion,

even

28 The deſultory motion of the piſtons

even with a moderate velocity, the ſtrain on the pipe would be very great. Indeed if it were poſſible to put the piſton inſtantaneouſly into motion with a finite velocity, the ſtrain on the pipe, tending to burſt it, would be next to infinite. But this ſeems impoſſible in nature; all changes of motion *which we obſerve* are gradual, becauſe all impelling bodies have ſome elaſticity or ſoftneſs by which they yield to compreſſion. And, in the way in which piſtons are commonly moved, *viz.* by cranks, or ſomething analogous to them, the motion is *very ſenſibly* gradual. But ſtill the air-veſſel tends to make the motion along the main-pipe leſs deſultory, and therefore diminiſhes thoſe ſtrains which would really take place in the main-pipe. It acts like the ſprings of a travelling carriage, whoſe jolts are incomparably leſs than thoſe of a cart; and by this means really enables a given force to propel a greater quantity of water in the ſame time.

29 Corrected.

We may here by the way obſerve, that the attemps of mechanicians to correct this unequal motion of the piſton-rod are miſplaced, and if it could be done, would greatly hurt a pump. One of the beſt methods of producing this effect is to make the piſton-rod conſiſt of two parallel bars, having teeth in the ſides which front each other. Let a toothed wheel be placed between them, having only the half of its circumference furniſhed with teeth. It is evident, without any farther deſcription, that if this wheel be turned uniformly round its axis, the piſton-rod will be moved uniformly up and down without intermiſſion. This has often been put in practice; but the machine always went by jolts, and ſeldom laſted a few days. Unſkilled mechanicians attributed this to defect in the execution: but the fault is eſſential, and lies in the principle.

30 But on a wrong principle.

The machine could not perform one ſtroke, if the firſt mover did not ſlacken a little, or the different parts of the machine did not yield by bending or by compreſſion; and no ſtrength of materials could withſtand the violence of the ſtrains at every reciprocation of the motion. This is chiefly experienced in great works which are put in motion by a water-wheel, or ſome other equal power exerted on the maſs of matter of which the machine conſiſts. The water-wheel being of great weight, moves with conſiderable ſteadineſs or uniformity; and when an additional reſiſtance is oppoſed to it by the beginning of a new ſtroke of the piſton, its great quantity of motion is but little affected by this addition, and it proceeds very little retarded; and the machine muſt either yield a little by bending and compreſſion, or go to pieces, which is the common event. Cranks are free from this inconvenience, becauſe they accelerate the piſton gradually, and bring it gradually to reſt, while the water-wheel moves round with almoſt perfect uniformity. The only inconvenience (and it may be conſiderable) attending this ſlow motion of the piſton at the beginning of its ſtroke is, that the valves do not ſhut with rapidity, ſo that ſome water gets back through them. But when they are properly formed and loaded, this is but trifling.

31 Theſe equable pumps deliver very little more water than the others.

We muſt not imagine, that becauſe the ſtream produced by the aſſiſtance of an air-barrel is almoſt perfectly equable, and becauſe as much water runs out during the returning of the piſton as during its active ſtroke, it therefore doubles the quantity of water. No more water can run out than what is ſent forward by the piſton during its effective ſtroke. The continued ſtream is produced only by preventing the whole of this water from being diſcharged during this time, and by providing a propelling force to act during the piſton's return. Nor does it enable the moving force of the piſton to produce a double effect: for the compreſſion which is produced in the air-veſſel, more than what is neceſſary for merely balancing the quieſcent column of water, reacts on the piſton, reſiſting its compreſſion juſt as much as the column of water would do which produces a velocity equal to that of the efflux. Thus if the water is made to ſpout with the velocity of eight feet per ſecond, this would require an additional column of one foot high, and this would juſt balance the compreſſion in the air-veſſel, which maintains this velocity during the non-action of the piſton. It is, however, a matter of fact, that a pump furniſhed with an air-veſſel delivers a little more water than it would do without it. But the difference depends on the combination of many very diſſimilar circumſtances, which it is extremely difficult to bring into calculation. Some of theſe will be mentioned afterwards.

To deſcribe, or even to enumerate, the immenſe variety of combinations of theſe three ſimple pumps would fill a volume. We ſhall ſelect a few, which are more deſerving of notice.

32 The ſucking pump converted into a lifting pump.

I. The common ſucking-pump may, by a ſmall addition, be converted into a lifting-pump, fitted for propelling the water to any diſtance, and with any velocity.

Fig. 14. is a ſucking-pump, whoſe working-barrel ACDB has a lateral pipe AEGHF connected with it cloſe to the top. This terminates in a *main* or riſing pipe IK, furniſhed or not with a valve L. The top of the barrel is ſhut up by a ſtrong plate MN, having a hollow neck terminating in a ſmall flanch. The piſton rod QR paſſes through this neck, and is nicely turned and poliſhed. A number of rings of leather are put over the rod, and ſtrongly compreſſed round it by another flanch and ſeveral ſcrewed bolts, as is repreſented at OP. By this contrivance the rod is cloſely graſped by the leathers, but may be eaſily drawn up and down, while all paſſage of air or water is effectually prevented.

The piſton S is perforated, and furniſhed with a valve opening upwards. There is alſo a valve T on the top of the ſuction-pipe YX; and it will be of advantage, though not abſolutely neceſſary, to put a valve L at the bottom of the riſing pipe. Now ſuppoſe the piſton at the bottom of the working-barrel. When it is drawn up, it tends to compreſs the air above it, becauſe the valve in the piſton remains ſhut by its own weight. The air therefore is driven through the valve L into the riſing pipe, and eſcapes. In the mean time, the air which occupied the ſmall ſpace between the piſton and the valve T expands into the upper part of the working barrel; and its elacity is ſo much diminiſhed thereby, that the atmoſphere preſſes the water of the ciſtern into the ſuction-pipe, where it will riſe till an equilibrium is again produced. The next downward ſtroke of the piſton allows the air, which had come from the ſuction-pipe into the barrel during the aſcent of the piſton, to get through its valve. Upon drawing up the piſton, this air is alſo drawn off through the riſing pipe. Repeating this proceſs brings the water at laſt into the working-barrel, and it is then driven along the riſing-pipe by the piſton.

33
Advantages of this converſion.

This is one of the beſt forms of a pump. The rarefaction may be very perfect, becauſe the piſton can be brought ſo near to the bottom of the working-barrel: and, for forcing water in oppoſition to great preſſures, it appears preferable to the common forcing-pump; becauſe in that the piſton rods are compreſſed and expoſed to bending, which greatly hurts the pump by wearing the piſton and barrel on one ſide. This ſoon renders it leſs tight, and much water ſquirts out by the ſides of the piſton. But in this pump the piſton rod is always drawn or pulled, which keeps it ſtraight; and rods exert a much greater force in oppoſition to a pull than in oppoſition to compreſſion. The collar of leather round the piſton-rods is found by experience to need very little repairs, and is very impervious to water. The whole is very acceſſible for repairs; and in this reſpect much preferable to the common pump in deep mines, where every fault of the piſton obliges us to draw up ſome hundred feet of piſton-rods. By this addition, too, any common pump for the ſervice of a houſe is converted into an engine for extinguiſhing fire, or may be made to convey the water to every part of the houſe; and this without hurting or obſtructing its common uſes. All that is neceſſary is to have a large cock on the upper part of the working-barrel oppoſite to the lateral pipe in this figure. This cock ſerves for a ſpout when the pump is uſed for common purpoſes; and the merely ſhutting this cock converts the whole into an engine for extinguiſhing fire or for ſupplying diſtant places with water. It is ſcarcely neceſſary to add, that for theſe ſervices it will be proper to connect an air-veſſel with ſome convenient part of the riſing pipe, in order that the current of the water may be continual.

34
Equable ſtreams produced in great works by combinations.

We have frequently ſpoken of the advantages of a continued current in the main pipe. In all great works a conſiderable degree of uniformity is produced by the manner of diſpoſing the actions of the different pumps; for it is very rarely that a machine works but one pump. In order to maintain ſome uniformity in the reſiſtance, that it may not all be oppoſed at once to the moving power, with intervals of total inaction, which would produce a very hobbling motion, it is uſual to diſtribute the work into portions, which ſucceed alternately; and thus both diminiſh the ſtrain, and give greater uniformity of action, and frequently enable a natural power which we can command, to perform a piece of work, which would be impoſſible if the whole reſiſtance were oppoſed at once. In all pump machines therefore we are obviouſly directed to conſtruct them ſo that they may give motion to at leaſt two pumps, which work alternately. By this means a much greater uniformity of current is produced in the main pipe. It will be rendered ſtill more uniform if four are employed, ſucceeding each other at the interval of one quarter of the time of a complete ſtroke.

35
A ſingle pump for this purpoſe deſcribed.

But ingenious men have attempted the ſame thing with a ſingle pump, and many different conſtructions for this purpoſe have been propoſed and executed. The thing is not of much importance, nor of great reſearch. We ſhall content ourſelves therefore with the deſcription of one that appears to us the moſt perfect, both in reſpect of ſimplicity and effect.

II. It conſiſts of a working-barrel AB (fig. 15.) cloſe at both ends. The piſton C is ſolid, and the rod OP paſſes through a collar of leathers in the plate, which cloſes the upper end of the working-barrel. This barrel communicates laterally with two pipes H, K; the communication *m* and *n* being as near to the top and bottom of the barrel as poſſible. Adjoining to the paſſage *m* are two valves F and G opening upwards. Similar valves accompany the paſſage *n*. The two pipes H and K unite in a larger riſing pipe L. They are all repreſented as in the ſame plane; but the upper ends muſt be bent backwards, to give room for the motion of the piſton-rod OP.

Suppoſe the piſton cloſe to the entry of the lateral pipe *n*, and that it is drawn up: it compreſſes the air above it, and drives it through the valve G, where it eſcapes along the riſing pipe; at the ſame time it rarefies the air in the ſpace below it. Therefore the weight of the atmoſphere ſhuts the valve E, and cauſes the water of the ciſtern to riſe through the valve D, and fill the lower part of the pump. When the piſton is puſhed down again, this water is firſt driven through the valve E, becauſe D immediately ſhuts; and then moſt of the air which was in this part of the pump at the beginning goes up through it, ſome of the water coming back in its ſtead. In the mean time, the air which remained in the upper part of the pump after the aſcent of the piſton is rarefied by its deſcent; becauſe the valve G ſhuts as ſoon as the piſton begins to deſcend, the valve F opens, the air in this ſuction pipe F*f* expands into the barrel, and the water riſes into the pipes by the preſſure of the atmoſphere. The next riſe of the piſton muſt bring more water into the lower part of the barrel, and muſt drive a little more air through the valve G, namely, part of that which had come out of the ſuction-pipe F*f*; and the next deſcent of the piſton muſt drive more water into the riſing pipe H, and along with it moſt if not all of the air which remained below the piſton, and muſt rarefy ſtill more the air remaining above the piſton; and more water will come in through the pipe F*f*, and get into the barrel. It is evident that a few repetitions will at laſt fill the barrel on both ſides of the piſton with water. When this is accompliſhed, there is no difficulty in perceiving how, at every riſe of the piſton, the water of the ciſtern will come in by the valve D, and the water in the upper part of the barrel will be driven thro' the valve G; and, in every deſcent of the piſton, the water of the ciſtern will come into the barrel by the valve F, and the water below the piſton will be driven through the valve E: and thus there will be a continual influx into the barrel through the valves D and F, and a continual diſcharge along the riſing pipe L through the valves E and G.

36
It is equivalent to two forcing-pumps.

This machine is, to be ſure, equivalent to two forcing pumps, although it has but one barrel and one piſton; but it has no ſort of ſuperiority. It is not even more economical in moſt caſes; becauſe we apprehend that the additional workmanſhip will fully compenſate for the barrel and piſton that is ſaved. There is indeed a ſaving in the reſt of the machinery, becauſe one lever produces both motions. We cannot therefore ſay that it is inferior to two pumps; and we acknowledge that there is ſome ingenuity in the contrivance.

We recommend to our readers the peruſal of Belidor's dor's *Architecture Hydraulique*, where is to be found a great variety of combinations and forms of the ſimple pumps; but we muſt caution them with reſpect to his theories, which in this article are extremely defective. Alſo in Leupold's *Theatrum Machinarum Hydraulicarum*, there is a prodigious variety of all kinds of pumps, many of them very ſingular and ingenious, and many which have particular advantages, which may ſuit local circumſtances, and give them a preference. But it would be improper to ſwell a work of this kind with ſo many peculiarities; and a perſon who makes himſelf maſter of the principles delivered here in ſufficient detail, can be at no loſs to ſuit a pump to his particular views, or to judge of the merit of ſuch as may be propoſed to him.

37 uthors ecom- ended.

We muſt now take notice of ſome very conſiderable and important varieties in the form and contrivance of the eſſential parts of a pump.

38 The orcing pump diffe- rently con- tructed. Plate ccccxxv.

III. The forcing pump is ſometimes of a very different form from that already deſcribed. Inſtead of a piſton, which applies itſelf to the inſide of the barrel, and ſlides up and down in it, there is a long cylinder POQ (fig. 16.) nicely turned and poliſhed on the outſide, and of a diameter ſomewhat leſs than the inſide of the barrel. This cylinder (called a PLUNGER) ſlides through a collar of leathers on the top of the working barrel, and is conſtructed as follows. The top of the barrel terminates in a flanch *a b*, pierced with four holes for receiving ſcrew-bolts. There are two rings of metal, *c d*, *e f*, of the ſame diameter, and having holes correſponding to thoſe in the flanch. Four rings of ſoft leather, of the ſame ſize, and ſimilarly pierced with holes, are well ſoaked in a mixture of oil, tallow, and a little roſin. Two of theſe leather rings are laid on the pump flanch, and one of the metal rings above them. The plunger is then thruſt down through them, by which it turns their inner edges downwards. The other two rings are then ſlipped on at the top of the plunger, and the ſecond metal ring is put over them, and then the whole are ſlid down to the metal ring. By this the inner edges of the laſt leather rings are turned upwards. The three metal rings are now forced together by the ſcrewed bolts; and thus the leathern rings are ſtrongly compreſſed between them, and made to graſp the plunger ſo cloſely that no preſſure can force the water through between. The upper metal ring juſt allows the plunger to paſs through it, but without any play; ſo that the turned up edges, of the leathern rings do not come up between the plunger and the upper metal ring, but are lodged in a little conical taper, which is given to the inner edge of the upper plate, its hole being wider below than above. It is on this trifling circumſtance that the great tightneſs of the collar depends. To prevent the leathers from ſhrinking by drought, there is uſually a little ciſtern formed round the head of the pump, and kept full of water. The plunger is either forced down by a rod from a working beam, or by a ſet of metal-weights laid on it, as is repreſented in the figure.

39 Its mode of operation.

It is hardly neceſſary to be particular in explaining the operation of this pump. When the plunger is at the bottom of the barrel, touching the fixed valve M with its lower extremity, it almoſt completely fills it. That it may do it completely, there is ſometimes a ſmall pipe RSZ branching out from the top of the barrel, and fitted with a cock at S. Water is admitted till the barrel is completely filled, and the cock is then ſhut. Now when the plunger is drawn up, the valve N in the riſing pipe muſt remain ſhut by the preſſure of the atmoſphere, and a void muſt be made in the barrel. Therefore the valve M on the top of the ſuction-pipe muſt be opened by the elaſticity of the air in this pipe, and the air muſt expand into the barrel; and, being no longer a balance for the atmoſphere, the water in the ciſtern muſt be forced into the ſuction-pipe, and riſe in it to a certain height. When the plunger deſcends, it muſt drive the water through the valve N (for the valve M will immediately ſhut), and along with it moſt of the air which had come into the barrel. And as this air occupied the upper part of the barrel, part of it will remain when the plunger has reached the bottom; but a ſtroke or two will expel it all, and then every ſucceeding ſtroke of the deſcending piſton will drive the water along the riſing pipe, and every aſcent of the plunger will be followed by the water from the ciſtern.

The advantage propoſed by this form of piſton is, that it may be more accurately made and poliſhed than the inſide of a working barrel, and it is of much eaſier repair. Yet we do not find that it is much uſed, although an invention of laſt century (we think by Sir Samuel Morland), and much praiſed by the writers on theſe ſubjects.

40 Sucking-pump ſimilarly varied.

It is eaſy to ſee that the ſucking-pump may be varied in the ſame way. Suppoſe this plunger to be open both at top and bottom, but the bottom filled with a valve opening upward. When this is puſhed to the bottom of the barrel, the air which it tends to compreſs lifts the valve (the lateral pipe FIK being taken away and the paſſage ſhut up), and eſcapes through the plunger. When it is drawn up, it makes the ſame rarefaction as the ſolid plunger, becauſe the valve at O ſhuts, and the water will come up from the ciſtern as in the former caſe. If the plunger be now thruſt down again, the valve M ſhuts, the valve O is forced open, and the plunger is filled with water. This will be lifted by it during its next aſcent; and when it is puſhed down again, the water which filled it muſt now be puſhed out, and will flow over its ſides into the ciſtern at the head of the barrel. Inſtead of making the valve at the bottom of the piſton, it may be made at the top; but this diſpoſition is much inferior, becauſe it cannot rarefy the air in the barrel one half. This is evident; for the capacity of the barrel and plunger together cannot be twice the capacity of the barrel.

41 Another form of the ſucking-pump.

IV. It may be made after a ſtill different form, as repreſented in fig. 17. Here the ſuction-pipe CO comes up through a ciſtern KMNL deeper or longer than the intended ſtroke of the piſton, and has a valve C at top. The piſton, or what acts in lieu of it, is a tube AHGB, open at both ends, and of a diameter ſomewhat larger than that of the ſuction-pipe. The interval between them is filled up at HG by a ring or belt of ſoft leather, which is faſtened to the *outer* tube, and moves up and down with it ſliding along the ſmoothly poliſhed ſurface of the ſuction-pipe with very little friction. There is a valve I on the top of this piſton, opening upwards. Water is poured into the outer ciſtern.

42 And its mode of operation.

The outer cylinder or piſton being drawn up from the bottom, there is a great rarefaction of the air which was between them, and the atmoſphere preſſes the water up through the ſuction-pipe to a certain height; for the valve I keeps ſhut by the preſſure of the atmoſphere and its own weight. Puſhing down the piſton cauſes the air, which had expanded from the ſuction-pipe into the piſton, to eſcape through the valve I; drawing it up a ſecond time, allows the atmoſphere to preſs more water into the ſuction-pipe, to fill it, and alſo part of the piſton. When this is puſhed down again, the water which had come through the valve C is now forced out through the valve I into the ciſtern KMNL, and now the whole is full of water. When, therefore, the piſton is drawn up, the water follows, and fills it, if not 33 feet above the water in the ciſtern; and when it is puſhed down again, the water which filled the piſton is all thrown out into the ciſtern; and after this it delivers its full contents of water every ſtroke. The water in the ciſtern KMNL effectually prevents the entry of any air between the two pipes; ſo that a very moderate compreſſon of the belt of ſoft leather at the mouth of the piſton cylinder is ſufficient to make all perfectly tight.

43
The piſton cylinder differently formed.

It might be made differently. The ring of leather might be faſtened round the top of the inner cylinder at DE, and ſlide on the inſide of the piſton cylinder; but the firſt form is moſt eaſily executed. Muſchenbroeck has given a figure of this pump in his large ſyſtem of natural philoſophy, and ſpeaks very highly of its performance. But we do not ſee any advantage which it poſſeſſes over the common ſucking-pump. He indeed ſays that it is without friction, and makes no mention of the ring of leather between the two cylinders. Such a pump will raiſe water extremely well to a ſmall height, and it ſeems to have been a model only which he had examined: But if the ſuction-pipe is long, it will by no means do without the leather; for on drawing up the piſton, the water of the upper ciſtern will riſe between the piſton, and fill the piſton, and none will come up through the ſuction-pipe.

44
Pumps without friction not of important uſe.

We may take this opportunity of obſerving, that the many ingenious contrivances of pumps without friction are of little importance in great works; becauſe the friction which is completely ſufficient to prevent all eſcape of water in a well-conſtructed pump is but a very trifling part of the whole force. In the great pumps which are uſed in mines, and are worked by a ſteam-engine, it is very uſual to make the piſtons and valves without any leather whatever. The working barrel is bored truly cylindrical, and the piſton is made of metal of a ſize that will juſt paſs along it without ſticking. When this is drawn up with the velocity competent to a properly loaded machine, the quantity of water which eſcapes round the piſton is inſignificant. The piſton is made without leathers, not to avoid friction, which is alſo inſignificant in ſuch works; but to avoid the neceſſity of frequently drawing it up for repairs through ſuch a length of pipes.

45
Example of a ſimple pump without friction.

V. If a pump abſolutely without friction is wanted, the following ſeems preferable for ſimplicity and performance to any we have ſeen, when made uſe of in proper ſituations. Let NO (fig. 18.) be the ſurface of the water in the pit, and K the place of delivery. The pit muſt be as deep in water as from K to NO. ABCD is a wooden trunk, round or ſquare, open at both ends, and having a valve P at the bottom. The top of this trunk muſt be on a level with K, and has a ſmall ciſtern EADF. It alſo communicates laterally with a riſing pipe GHK, furniſhed with a valve at H opening upwards. LM is a beam of timber ſo fitted to the trunk as to fill it without ſticking, and is of at leaſt equal length. It hangs by a chain from a working beam, and is loaded on the top with weights exceeding that of the column of water which it diſplaces. Now ſuppoſe this beam allowed to deſcend from the poſition in which it is drawn in the figure; the water muſt riſe all around it, in the crevice which is between it and the trunk, and alſo in the riſing pipe; becauſe the valve P ſhuts, and H opens; ſo that when the plunger has got to the bottom, the water will ſtand at the level of K. When the plunger is again drawn up to the top by the action of the moving power, the water ſinks again in the trunk, but not in the riſing pipe, becauſe it is ſtopped by the valve H. Then allowing the plunger to deſcend again, the water muſt again riſe in the trunk to the level of K, and it muſt now flow out at K; and the quantity diſcharged will be equal to the part of the beam below the ſurface of the pit-water, deducting the quantity which fills the ſmall ſpace between the beam and the trunk. This quantity may be reduced almoſt to nothing; for if the inſide of the trunk and the outſide of the beam be made tapering, the beam may be let down till they exactly fit; and as this may be done in ſquare work, a good workman can make it exceedingly accurate. But in this caſe, the lower half of the beam and trunk muſt not taper; and this part of the trunk muſt be of ſufficient width round the beam to allow free paſſage into the riſing pipe. Or, which is better, the riſing pipe muſt branch off from the bottom of the trunk. A diſcharge may be made from the ciſtern EADF, ſo that as little water as poſſible may deſcend along the trunk when the piſton is raiſed.

46
Its excellencies are conſiderable.

One great excellence of this pump is, that it is perfectly free from all the deficiencies which in common pumps reſult from want of being air-tight. Another is, that the quantity of water raiſed is preciſely equal to the power expended; for any want of accuracy in the work, while it occaſions a diminution of the quantity of water diſcharged, makes an equal diminution in the weight which is neceſſary for puſhing down the plunger. We have ſeen a machine conſiſting of two ſuch pumps ſuſpended from the arms of a long beam, the upper ſide of which was formed into a walk with a rail on each ſide. A man ſtood on one end till it got to the bottom, and then walked ſoberly up to the other end, the inclination being about twenty-five degrees at firſt, but gradually diminiſhed as he went along, and changed the load of the beam. By this means he made the other end go to the bottom, and ſo on alternately, with the eaſieſt of all exertions, and what we are moſt fitted for by our ſtructure. With this machine, a very feeble old man, weighing 110 pounds, raiſed 7 cubic feet of water 11½ feet high in a minute, and continued working 8 or 10 hours every day. A ſtout young man, weighing nearly 135 pounds, raiſed 8¼ to the ſame height; and when he carried 30 pounds, conveniently ſlung about him, he raiſed 9¼ feet to this height, working 10 hours a-day without fatiguing himſelf. This exceeds Deſagulier's maximum of a hogſhead of water 10 feet high in a minute, in the proportion

47 But it is limited. portion of 9 to 7 nearly. It is limited to very moderate heights; but in ſuch ſituations it is very effectual. It was the contrivance of an untaught labouring man, poſſeſſed of uncommon mechanical genius. We ſhall have occaſion to mention, with reſpect, ſome other contrivances of the ſame perſon in the article *Water-Works*.

48 Haſkin's pump deſcribed. VI. The moſt ingenious contrivance of a pump without friction is that of Mr Haſkins, deſcribed by Deſaguliers, and called by him the Quickſilver Pump. Its conſtruction and mode of operation are pretty complicated; but the following preliminary obſervations will, we hope, render it abundantly plain.

Let *i l m k* (fig. 19.) be a cylindrical iron pipe, about ſix feet long, open at top. Let *e g h f* be another cylinder, connected with it at the bottom, and of ſmaller diameter. It may either be ſolid, or, if hollow, it muſt be cloſe at top. Let *a c d b* be a third iron cylinder, of an intermediate diameter, ſo that it may move up and down between the other two without touching either, but with as little interval as poſſible. Let this middle cylinder communicate by means of the pipe AB, with the upright pipe FE, having valves C and D (both opening upwards) adjoining to the pipe of communication. Suppoſe the outer cylinder ſuſpended by chains from the end of a working beam, and let mercury be poured into the interval between the three cylinders till it fills the ſpace to *o p*, about $\frac{1}{4}$ of their height. Alſo ſuppoſe that the lower end of the pipe FE is immerſed into a ciſtern of water, and that the valve D is leſs than 33 feet above the ſurface of this water.

49 Its mode of operation. Now ſuppoſe a perforation made ſomewhere in the pipe AB, and a communication made with an air-pump. When the air-pump is worked, the air contained in CE, in AB, and in the ſpace between the inner and middle cylinders, is rarefied, and is abſtracted by the air-pump; for the valve D immediately ſhuts. The preſſure of the atmoſphere will cauſe the water to riſe in the pipe CE, and will cauſe the mercury to riſe between the inner and middle cylinders, and ſink between the outer and middle cylinders. Let us ſuppoſe mercury 12 times heavier than water: Then for every foot that the water riſes in EC, the level between the outſide and inſide mercury will vary an inch; and if we ſuppoſe DE to be 30 feet, then if we can rarefy the air ſo as to raiſe the water to D, the outſide mercury will be depreſſed to *q, r*, and the inſide mercury will have riſen to *s, t*, *s q* and *t r* being about 30 inches. In this ſtate of things, the water will run over by the pipe BA, and every thing will remain nearly in this poſition. The columns of water and mercury balance each other, and balance the preſſure of the atmoſphere.

While things are in this ſtate of equilibrium, if we allow the cylinders to deſcend a little, the water will riſe in the pipe FE, which we may now conſider as a ſuction-pipe; for by this motion the capacity of the whole is enlarged, and therefore the preſſure of the atmoſphere will ſtill keep it full, and the ſituation of the mercury will again be ſuch that all ſhall be in equilibrio. It will be a little lower in the inſide ſpace and higher in the outſide.

Taking this view of things, we ſee clearly how the water is ſupported by the atmoſphere at a very conſiderable height. The apparatus is analogous to a ſyphon which has one leg filled with water and the other with mercury. But it was not neceſſary to employ an air-pump to fill it. Suppoſe it again empty, and all the valves ſhut by their own weight. Let the cylinders deſcend a little. The capacity of the ſpaces below the valve D is enlarged, and therefore the included air is rarefied, and ſome of the air in the pipe CE muſt diffuſe itſelf into the ſpace quitted by the inner cylinder. Therefore the atmoſphere will preſs ſome water up the pipe FE, and ſome mercury into the inner ſpace between the cylinders. When the cylinders are raiſed again, the air which came from the pipe CE would return into it again, but is prevented by the valve C.—Raiſing the cylinders to their former height would compreſs this air; it therefore lifts the valve D, and eſcapes. Another depreſſion of the cylinders will have a ſimilar effect. The water will riſe higher in FC, and the mercury in the inner ſpace; and then, after repeated ſtrokes, the water will paſs the valve C, and fill the whole apparatus, as the air-pump had cauſed it to do before.—The poſition of the cylinders, when things are in this ſituation, is repreſented in fig. 20, the outer and inner cylinders in their loweſt poſition having deſcended about 30 inches. The mercury in the outer ſpace ſtands at *q, r*, a little above the middle of the cylinders, and the mercury in the inner ſpace is near the top *t s* of the inner cylinder. Now let the cylinders be drawn up. The water above the mercury cannot get back again through the valve C, which ſhuts by its own weight. We therefore attempt to compreſs it; but the mercury yields, and deſcends in the inner ſpace, and riſes in the outer till both are quickly on a level, about the height *v v*. If we continue to raiſe the cylinders, the compreſſion forces out more mercury, and it now ſtands lower in the inner than in the outer ſpace. But that there may be ſomething to balance this inequality of the mercurial columns, the water goes through the valve D, and the equilibrium is reſtored when the height of the water in the pipe ED above the ſurface of the internal mercury is 12 times the difference of the mercurial columns (on the former ſuppoſition of ſpecific gravity.) If the quantity of water is ſuch as to riſe two feet in the pipe ED, the mercury in the outer ſpace will be two inches higher than that in the inner ſpace. Another depreſſion of the cylinders will again enlarge the ſpace within the apparatus, the mercury will take the poſition of fig. 19. and more water will come in. Raiſing the cylinders will ſend this water four feet up the pipe ED, and the mercury will be four inches higher in the inner than in the outer ſpace. Repeating this operation, the water will be raiſed ſtill higher in DE; and this will go on till the mercury in the outer ſpace reaches the top of the cylinder; and this is the limit of the performance. The dimenſions with which we ſet out will enable the machine to raiſe the water about 30 feet in the pipe ED; which, added to the 30 feet of CF, makes the whole height above the pit-water 60 feet. By making the cylinders longer, we increaſe the height of FD. This machine muſt be worked with great attention, and but ſlowly; for at the beginning of the forcing ſtroke the mercury very rapidly ſinks in the inner ſpace and riſes in the outer, and will daſh out and be loſt. To pre-

vent

vent this as much as poſſible, the outer cylinder terminates in a ſort of cup or diſh, and the inner cylinder ſhould be tapered atop.

50 Ingenuity of the contrivance great

51 But the advantage trifling.

The machine is exceedingly ingenious and refined; and there is no doubt but that its performance will exceed that of any other pump which raiſes the water to the ſame height, becauſe friction is completely avoided, and there can be no want of tightneſs of the piſton.—But this is all its advantage; and, from what has been obſerved, it is but trifling. The expence would be enormous; for with whatever care the cylinders are made, the interval between the inner and outer cylinders muſt contain a very great quantity of mercury. The middle cylinder muſt be made of iron plate, and muſt be without a ſeam, for the mercury would diſſolve every ſolder. For ſuch reaſons, it has never come into general uſe. But it would have been unpardonable to have omitted the deſcription of an invention which is ſo original and ingenious; and there are ſome occaſions where it may be of great uſe, as in nice experiments for illuſtrating the theory of hydraulics, it would give the fineſt piſtons for meaſuring the preſſures of water in pipes, &c. It is on preciſely the ſame principle that the cylinder bellows, deſcribed in the article PNEUMATICS, are conſtructed.

52 Deſcription of another pump without friction.

We beg leave to conclude this part of the ſubject with the deſcription of a pump without friction, which may be conſtructed in a variety of ways by any common carpenter, without the aſſiſtance of the pump-maker or plumber, and will be very effective for raiſing a great quantity of water to ſmall heights, as in draining marſhes, marle pits, quarries, &c. or even for the ſervice of a houſe.

VII. ABCD (fig. 21.) is a ſquare trunk of carpenter's work open at both ends, and having a little ciſtern and ſpout at top. Near the bottom there is a partition made of board, perforated with a hole E, and covered with a clack. *ſſſſ* repreſents a long cylindrical bag or pudding, made of leather or of double canvas, with a fold of thin leather ſuch as ſheepſkin between the canvas bags. This is firmly nailed to the board E with ſoft leather between. The upper end of this bag is fixed on a round board, having a hole and valve F. This board may be turned in the lathe with a groove round its edge, and the bag faſtened to it by a cord bound tight round it. The fork of the piſton-rod FG is firmly fixed into this board; the bag is kept diſtended by a number of wooden hoops or rings of ſtrong wire *ſſ*, *ſſ*, *ſſ*, &c. put into it at a few inches diſtance from each other. It will be proper to connect theſe hoops before putting them in, by three or four cords from top to bottom, which will keep them at their proper diſtances. Thus will the bag have the form of a barber's bellows powder-puff. The diſtance between the hoops ſhould be about twice the breadth of the rim of the wooden ring to which the upper valve and piſton-rod are fixed.

53 Its mode of operation, &c.

Now let this trunk be immerſed in the water. It is evident that if the bag be ſtretched from the compreſſed form which its own weight will give it by drawing up the piſton-rod, its capacity will be enlarged, the valve F will be ſhut by its own weight, the air in the bag will be rarefied, and the atmoſphere will preſs the water into the bag. When the rod is thruſt down again, this water will come out by the valve F, and fill part of the trunk. A repetition of the operation will have a ſimilar effect; the trunk will be filled, and the water will at laſt be diſcharged by the ſpout.

Here is a pump without friction, and perfectly tight. For the leather between the folds of canvas renders the bag impervious both to air and water. And the canvas has very conſiderable ſtrength. We know from experience that a bag of ſix inches diameter, made of ſail-cloth nº 3. with a ſheep ſkin between, will bear a column of 15 feet of water, and ſtand ſix hours work *per* day for a month without failure, and that the pump is conſiderably ſuperior in effect to a common pump of the ſame dimenſions. We muſt only obſerve, that the length of the bag muſt be three times the intended length of the ſtroke; ſo that when the piſton-rod is in its higheſt poſition, the angles or ridges of the bag may be pretty acute. If the bag be more ſtretched than this, the force which muſt be exerted by the labourer becomes much greater than the weight of the column of water which he is raiſing. If the pump be laid aſlope, which is very uſual in theſe occaſional and haſty drawings, it is neceſſary to make a guide for the piſton-rod within the trunk, that the bag may play up and down without rubbing on the ſides, which would quickly wear it out.

The experienced reader will ſee that this pump is very like that of Coſſet and De la Deuille, deſcribed by Belidor Vol. II. p. 120. and moſt writers on hydraulics. It would be ſtill more like it, if the bag were on the under ſide of the partition E, and a valve placed farther down the trunk. But we think that our form is greatly preferable in point of ſtrength. When in the other ſituation, the column of water lifted by the piſton tends to *burſt* the bag, and this with a great force, as the intelligent reader well knows. But in the form recommended here, the bag is *compreſſed*, and the ſtrain on each part may be made much leſs than that which tends to burſt a bag of ſix inches diameter. The nearer the rings are placed to each other the ſmaller will the ſtrain be.

The ſame bag-piſton may be employed for a forcing pump, by placing it below the partition, and inverting the valve; and it will then be equally ſtrong, becauſe the reſiſtance in this caſe too will act by compreſſion.

We now come naturally to the conſideration of the different forms which may be given to the piſtons and valves of a pump. A good deal of what we have been deſcribing already is reducible to this head; but, having a more general appearance, changing as it were the whole form and the ſtructure of the pump, it was not improper to keep theſe things together.

54 Piſtons ſhould have little friction.

The great deſideratum in a piſton is, that it be as tight as poſſible, and have as little friction as is conſiſtent with this indiſpenſable quality. We have already ſaid, that the common form, when carefully executed, has theſe properties in an eminent degree. And accordingly this form has kept its ground amidſt all the improvements which ingenious artiſts have made. Mr Belidor, an author of the firſt reputation, has given the deſcription of a piſton which he highly extols, and is undoubtedly a very good one, conſtructed from principle, and extremely well compoſed.

55 An improved one by Belidor.

It conſiſts of a hollow cylinder of metal *g h* (fig. 22.) pierced with a number of holes, and having at top a flanch AB, whoſe diameter is nearly equal to that of

Pump.

the working-barrel of the pump. This flanch has a groove round it. There is another flanch IK below, by which this hollow cylinder is faſtened with bolts to the lower end of the piſton, repreſented in fig. 23. This conſiſts of a plate CD, with a grooved edge ſimilar to AB, and an intermediate plate which forms the ſeat of the valve. The compoſition of this part is better underſtood by inſpecting the figure than by any deſcription. The piſton-rod HL is fixed to the upper plate by bolts through its different branches at G, G. This metal body is then covered with a cylindrical bag of leather, faſtened on it by cords bound round it, filling up the grooves in the upper and lower plates. The operation of the piſton is as follows.

A little water is poured into the pump, which gets paſt the ſides of the piſton, and lodges below in the fixed valve. The piſton being puſhed down dips into this water, and it gets into it by the valve. But as the piſton in deſcending compreſſes the air below it, this compreſſed air alſo gets into the inſide of the piſton, ſwells out the bag which ſurrounds it, and compreſſes it to the ſides of the working-barrel. When the piſton is drawn up again, it muſt remain tight, becauſe the valve will ſhut and keep in the air in its moſt compreſſed ſtate; therefore the piſton muſt perform well during the ſuction. It muſt act equally well when puſhed down again, and acting as a forcer; for however great the reſiſtance may be, it will affect the air within the piſton to the ſame degree, and keep the leather cloſe applied to the barrel. There can be no doubt therefore of the piſton's performing both its offices completely; but we imagine that the adheſion to the barrel will be greater than is neceſſary: it will extend over the whole ſurface of the piſton, and be equally great in every part of its ſurface; and we ſuſpect that the friction will therefore be very great. We have very high authority for ſuppoſing that the adheſion of a piſton of the common form, carefully made, will be ſuch as will make it perfectly tight; and it is evident that the adheſion of Belidor's piſton will be much greater, and it will be productive of worſe conſequences. If the leather bag is worn through in any one place, the air eſcapes, and the piſton ceaſes to be compreſſed altogether; whereas in the common piſton there will very little harm reſult from the leather being worn through in one place, eſpecially if it project a good way beyond the baſe of the cone. We ſtill think the common piſton preferable. Belidor's piſton would do much better inverted as the piſton of a ſucking pump; and in this ſituation it would be equal, but not ſuperior, to the common.

56
Its defects.

57
Another by the ſame author.

Belidor deſcribes another forcing piſton, which he had executed with ſucceſs, and prefers to the common wooden forcer. It conſiſts of a metal cylinder or cone, having a broad flanch united to it at one end, and a ſimilar flanch which is ſcrewed on the other end. Between theſe two plates are a number of rings of leather ſtrongly compreſſed by the two flanches, and then turned in a lathe like a block of wood, till the whole fits tight, when dry, into the barrel. It will ſwell, ſays he, and ſoften with the water, and withſtand the greateſt preſſures. We cannot help thinking this but an indifferent piſton. When it wears, there is nothing to ſqueeze it to the barrel. It may indeed be taken out and another ring or two of leather put in, or the flanches may be more ſtrongly ſcrewed together; but all this may be done with any kind of piſton; and this has therefore no peculiar merit.

58
Objections to it.

Pump.

59
Another recommended as preferable.

The following will, we preſume, appear vaſtly preferable, ABCD (fig. 24.) is the ſolid wooden or metal block of the piſton; EF is a metal plate, which is turned hollow or diſh-like below, ſo as to receive within it the ſolid block. The piſton rod goes through the whole, and has a ſhoulder above the plate EF, and a nut H below. Four ſcrew-bolts, ſuch as *i k*, *l m*, alſo go through the whole, having their heads *k*, *m* ſunk into the block, and nuts above at *i*, *l*. The packing or ſtuffing, as it is termed by the workmen, is repreſented at NO. This is made as ſolid as poſſible, and generally conſiſts of ſoft hempen twine well ſoaked in a mixture of oil, tallow, and roſin. The plate EF is gently ſcrewed down, and the whole is then put into the barrel, fitting it as tight as may be thought proper. When it wears looſe, it may be tightened at any time by ſcrewing down the nuts *i l*, which cauſe the edges of the diſh to ſqueeze out the packing, and compreſs it againſt the barrel to any degree.

60
Difficulties in conſtructing piſtons.

The greateſt difficulty in the conſtruction of a piſton is to give a ſufficient paſſage through it for the water, and yet allow a firm ſupport for the valve, and fixture for the piſton rod. We ſhall ſee preſently that it occaſions a conſiderable expence of the moving power to force a piſton with a narrow perforation through the water lodged in the working barrel. When we are raiſing water to a ſmall height, ſuch as 10 or 20 feet, the power ſo expanded amounts to a fourth part of the whole, if the water-way in the piſton is leſs than one-half of the ſection of the barrel, and the velocity of the piſton two feet per ſecond, which is very moderate. There can be no doubt, therefore, that metal piſtons are preferable, becauſe their greater ſtrength allows much wider apertures.

61
Conſiderably removed in one deſcribed by Belidor.

The following piſton, deſcribed and recommended by Belidor, ſeems as perfect in theſe reſpects as the nature of things will allow. We ſhall therefore deſcribe it in the author's own words as a model, which may be adopted with confidence in the greateſt works.

Plate CCCCXXVI.

"The body of the piſton is a truncated metal cone CCXX (fig. 25.) having a ſmall fillet at the greater end. Fig. 26 ſhows the profile, and fig. 27. the plan of its upper baſe; where appears a croſs bar DD, pierced with an oblong mortiſe E for receiving the tail of the piſton-rod. A band of thick and uniform leather AA (fig. 26. and 28.) is put round this cone, and ſecured by a braſs hoop BB firmly driven on its ſmaller end, where it is previouſly made thinner to give room for the hoop.

"This piſton is covered with a leather valve, fortified with metal plates GG (fig. 29.) Theſe plates are wider than the hole of the piſton, ſo as to reſt on its rim. There are ſimilar plates below the leather of a ſmaller ſize, that they may go into the hollow of the piſton; and the leather is firmly held between the metal plates by ſcrews H, H, which go through all. This is repreſented by the dotted circle IK. Thus the preſſure of the incumbent column of water is ſupported by the plates GG, whoſe circular edges reſt on the brim of the water-way, and thus ſtraight edges reſt on the croſs bar DD of fig. 26. and 27. This valve is laid on the top of the conical box in ſuch a manner that its middle FF reſts on the croſs bar. To bind all together, the end of the piſton-rod is formed like a croſs, and the arms MN (fig. 30.) are made to reſt on the diameter FF of the valve, the tail EP going through the hole E in the middle of the leather, and through the mortiſe E of the croſs bar of the box ; and alſo through another bar QR (fig. 28. and 29.) which is notched into the lower brim of the box. A key V is then driven into the hole T in the piſton-rod ; and this wedges all faſt. The bar QR is made ſtrong ; and its extremities project a little, ſo as to ſupport the braſs hoop BB which binds the leather band to the piſton-box. The adjoining ſcale gives the dimenſions of all the parts, as they were executed for a ſteam-engine near Condé, where the piſton gave complete ſatisfaction."

62 Advantages of this piſton.

This piſton has every advantage of ſtrength, tightneſs, and large water-way. The form of the valve (which has given it the name of the *butterfly-valve*) is extremely favourable to the paſſage of the water ; and as it has but half the motion of a complete circular valve, leſs water goes back while it is ſhutting.

63 Another ingenious and uſeful piſton deſcribed.

The following piſton is alſo ingenious, and has a good deal of merit. OPPO (fig. 31.) is the box of the piſton, having a perforation Q, covered above with a flat valve K, which reſts in a metal plate that forms the top of the box. ABCBA is a ſtirrup of iron to which the box is fixed by ſcrews *a, a, a, a*, whoſe heads are ſunk in the wood. This ſtirrup is perforated at C, to receive the end of the piſton-rod, and a nut H is ſcrewed on below to keep it faſt. DEFED is another ſtirrup, whoſe lower part at DD forms a hoop like the ſole of a ſtirrup, which embraces a ſmall part of the top of the wooden box. The lower end of the piſton-rod is ſcrewed ; and before it is put into the holes of the two ſtirrups (through which holes it ſlides freely) a broad nut G is ſcrewed on it. It is then put into the holes, and the nut H firmly ſcrewed up. The packing RR is then wound about the piſton as tight as poſſible till it completely fills the working barrel of the pump. When long uſe has rendered it in any degree looſe, it may be tightened again by ſcrewing down the nut G. This cauſes the ring DD to compreſs the packing between it and the projecting ſhoulder of the box at PP ; and thus cauſes it to ſwell out, and apply itſelf cloſely to the barrel.

64 Another on a differe principle.

We ſhall add only another form of a perforated piſton ; which being on a principle different from all the preceding, will ſuggeſt many others ; each of which will have its peculiar advantages. OO in fig. 32. repreſents the box of this piſton, fitted to the working barrel in any of the preceding ways as may be thought beſt. AB is a croſs bar of four arms, which is fixed to the top of the box. CF is the piſton-rod going through a hole in the middle of AB, and reaching a little way beyond the bottom of the box. It has a ſhoulder D, which prevents it going too far through. On the lower end there is a thick metal plate, turned conical on its upper ſide, ſo as to fit a conical ſeat PP in the bottom of the piſton-box.

When the piſton-rod is puſhed down, the friction on the barrel prevents the box from immediately yielding. The rod therefore ſlips through the hole of the croſs bar AB. The plate E, therefore, detaches itſelf from the box. When the ſhoulder D preſſes on the bar AB, the box muſt yield, and be puſhed down the barrels, and the water gets up through the perforation. When the piſton-rod is drawn up again, the box does not move till the plate E lodged in the ſeat PP, and thus ſhuts the water-way ; and then the piſton lifts the water which is above it, and acts as the piſton of a ſucking pump.

65 Its advantages.

This is a very ſimple and effective conſtruction, and makes a very tight valve. It has been much recommended by engineers of the firſt reputation, and is frequently uſed ; and from its ſimplicity, and the great ſolidity of which it is capable, it ſeems very fit for great works. But it is evident that the water-way is limited to leſs than one-half of the area of the working-barrel. For if the perforation of the piſton be one-half of the area, the diameter of the plate or ball EF muſt be greater ; and therefore leſs than half the area will be left for the paſſage of the water by its ſides.

66 Obſervations on valves.

We come now to conſider the forms which may be given to the valves of a hydraulic engine.

The requiſites of a valve are, that it ſhall be tight, of ſufficient ſtrength to reſiſt the great preſſures to which it is expoſed, that it afford a ſufficient paſſage for the water, and that it do not allow much to go back while it is ſhutting.

67 Clack valves.

We have not much to add to what has been ſaid already on this ſubject. The valves which accompany the pump of fig. 5. are called *clack valves*, and are of all the moſt obvious and common ; and the conſtruction deſcribed on that occaſion is as perfect as any. We only add, that as the leather is at laſt deſtroyed at the hinge by ſuch inceſſant motion, and it is troubleſome, eſpecially in deep mines, and under water, to undo the joint of the pump in order to put in a new valve, it is frequently annexed to a box like that of a piſton, made a little conical on the outſide, ſo as to fit a conical ſeat made for it in the pipe, as repreſented in fig. 33. and it has an iron handle like that of a baſket, by which it can be laid hold of by means of a long grappling-hook let down from above. Thus it is drawn up ; and being very gently tapered on the ſides, it ſticks very faſt in its place.

68 Defect in them.

The only defect of this valve is, that by opening very wide when puſhed up by the ſtream of water, it allows a good deal to go back during its ſhutting again. In ſome great machines which are worked by a ſlow turning crank, the return of the piſton is ſo very ſlow, that a ſenſible loſs is incurred by this ; but it is nothing like what Dr Deſaguliers ſays, one-half of a cylinder whoſe height is equal to the diameter of the valve.—For in ſuch machines, the laſt part of the upward ſtroke is equally ſlow, and the velocity of the water through the valve exceedingly ſmall, ſo that the valve is at this time almoſt ſhut.

69 Utility of the butterfly-valves.

The butterfly-valve repreſented in figures 29, &c. is free from moſt of thoſe inconveniences, and ſeems the moſt perfect of the clack valves. Some engineers make their great valves of a pyramidal form, conſiſting of four clacks, whoſe hinges are in the circumference of the water-way, and which meets with their points in the middle, and are ſupported by four ribs which riſe up from the ſides, and unite in the middle. This is an excellent form, affording the moſt ſpacious water-way, and ſhutting very readily. It ſeems to be the beſt poſſible for a piſton. The rod of the piſton is branched out on four ſides, and the branches go through the piſton-box, and are faſtened below with ſcrews. Theſe branches form the ſupport for the four clacks. We have ſeen a valve of this form in a pump of ſix feet diameter, which diſcharged 20 hogſheads of water every ſtroke, and made 12 ſtrokes in a minute, raiſing the water above 22 feet.

70 Button valves

There is another form of valve, called the *button* or *tail valve*. It conſiſts of a plate of metal AB (fig. 34.) turned conical, ſo as exactly to fit the conical cavity *a b* of its box. A tail CD projects from the under ſide, which paſſes through a croſs bar EF in the bottom of the box, and has a little knob at the end, to hinder the valve from riſing too high.

71 Very uſeful;

This valve, when nicely made, is unexceptionable. It has great ſtrength, and is therefore proper for all ſevere ſtrains, and it may be made perfectly tight by grinding. Accordingly it is uſed in all caſes where this is of indiſpenſable conſequence. It is moſt durable, and the only kind that will do for paſſages where ſteam or hot water is to go through. Its only imperfection is a ſmall water-way; which, from what has been ſaid, cannot exceed, nor indeed equal, one-half of the area of the pipe.

72 Though ſomewhat imperfect in the water-way.

If we endeavour to enlarge the water-way, by giving the cone very little taper, the valve frequently ſticks ſo faſt in the ſeat that no force can detach them.—And this ſometimes happens during the working of the machine and the jolts and blows given to the machine in taking it to pieces, in order to diſcover what has been the reaſon that it has diſcharged no water, frequently detaches the valve, and we find it quite looſe, and cannot tell what has deranged the pump. When this is guarded againſt, and the diminution of the water-way is not of very great conſequence, this is the beſt form of a valve.

73 A very ſimple valve deſcribed.

Analogous to this is the ſimpleſt of all valves, repreſented in fig. 35. It is nothing more than a ſphere of metal A, to which is fitted a ſeat with a ſmall portion BC of a ſpherical cavity. Nothing can be more effectual than this valve; it always falls into its proper place, and in every poſition fits it exactly. Its only imperfection is the great diminution of the water-way. If the diameter of the ſphere does not conſiderably exceed that of the hole, the touching parts have very little taper, and it is very apt to ſtick faſt. It oppoſes much leſs reſiſtance to the paſſage of the water than the flat under-ſurface of the button-valve. *N. B.* It would be an improvement of that valve to give it a taper-ſhape below like a boy's top. The ſpherical valve muſt not be made too light, otherwiſe it will he hurried up by the water, and much may go back while it is returning to its place.

74 A valve by Belidor uniting every requiſite.

Belidor deſcribes with great minuteneſs (vol. ii p. 221, &c.) a valve which unites every requiſite. But it is of ſuch nice and delicate conſtruction, and its defects are ſo great when this exactneſs is not attained, or is impaired by uſe, that we think it hazardous to introduce it into a machine in a ſituation where an intelligent and accurate artiſt is not at hand. For this reaſon we have omitted the deſcription, which cannot be given in few words, nor without many figures; and deſire our curious readers to conſult that author, or peruſe Dr Deſagulier's tranſlation of this paſſage. Its principle is preciſely the ſame with the following rude contrivance with which we ſhall conclude the deſcriptive part of this article.

75 Another valve on the ſame principle.

Suppoſe ABCD (fig. 36.) to be a ſquare wooden trunk. EF is a piece of oak-board, exactly fitted to the trunk in an oblique poſition, and ſupported by an iron pin which goes through it at I, one-third of its length from its lower extremity E. The two ends of this board are levelled, ſo as to apply exactly to the ſides of the trunk. It is evident, that if a ſtream of water comes in the direction BA, its preſſure on the part IF of this board will be greater than that upon EI. It will therefore force it up and ruſh through, making it ſtand almoſt parallel to the ſides of the trunk. To prevent its riſing ſo far, a pin muſt be put in its way. When this current of water changes its direction, the preſſure on the upper ſide of the board being again greateſt on the portion IF, it is forced back again to its former ſituation; and its two extremities reſting on the oppoſite ſides of the trunk, the paſſage is completely ſtopped. This board therefore performs the office of a valve; and this valve is the moſt perfect that can be, becauſe it offers the freeſt paſſage to the water, and it allows very little to get back while it is ſhutting; for the part IE brings up half as much water as IF allows to go down. It may be made extremely tight, by fixing two thin fillets H and G to the ſides of the trunk, and covering thoſe parts of the board with leather which applies to them; and in this ſtate it perfectly reſembles Belidor's fine valve.

76 Deſcription of an occaſional pump eaſily conſtructed.

And this conſtruction of the valve ſuggeſts, by the way, a form of an occaſional pump, which may be quickly ſet up by any common carpenter, and will be very effectual in ſmall heights. Let *a b c d e* (fig. 36.) be a ſquare box made to ſlide along this wooden trunk without ſhake, having two of its ſides projecting upwards, terminating like the gable-ends of a houſe. A piece of wood *e* is mortiſed into theſe two ſides, and to this the piſton-rod is fixed. This box being furniſhed with a valve ſimilar to the one below, will perform the office of a piſton. If this pump be immerſed ſo deep in the water that the piſton ſhall alſo be under water, we ſcruple not to ſay that its performance will be equal to any. The piſton may be made abundantly tight by covering its outſide neatly with ſoft leather. And as no pipe can be bored with greater accuracy than a very ordinary workman can make a ſquare trunk, we preſume that this pump will not be very deficient even for a conſiderable ſuction.

77 The motion of water in pumps

We now proceed to the laſt part of the ſubject, to conſider the motion of water in pumps, in reference to the force which muſt be employed. What we have hitherto ſaid with reſpect to the force which muſt be applied to a piſton, related only to the ſuſtaining the water at a certain height: but in actual ſervice we muſt not only do this, but we muſt diſcharge it at the place of delivery in a certain quantity; and this muſt require a force ſuperadded, to what is neceſſary for its mere ſupport at this height.

78 An intricate ſubject.

This is an extremely intricate and difficult ſubject, and very imperfectly underſtood even by profeſſed engineers. The principles on which this knowledge muſt be founded are of a much more abſtruſe nature than the ordinary laws of hydroſtatics; and all the genius of Newton was employed in laying the foundation of this part of phyſical ſcience. It has been much cultivated in the courſe of this century by the firſt mathematicians of Europe. Daniel and John Bernoulli have written very elaborate treatiſes on the ſubject, under the very oppoſite name of **Hydrodynamics**; in which, although they have added little or nothing to the fundamental propoſitions eſtabliſhed in ſome ſort by Newton, and acquieſced in by them, yet they have greatly contributed to our progreſs in it by the *methods* which they have purſued in making application of thoſe fundamental propoſitions to the moſt important caſes. It muſt be acknowledged, however, that both theſe propoſitions, and the extenſions given them by theſe authors, are ſupported by a train of argument that is by no means unexceptionable; and that they proceed on aſſumptions or poſtulates which are but nearly true in any caſe, and in many are inadmiſſible: and it remains to this hour a wonder or puzzle how theſe propoſitions and their reſults correſpond with the phenomena which we obſerve.

79
The theory denominated Hydrodynamics,

But fortunately this correſpondence does obtain to a certain extent. And it ſeems to be this correſpondence chiefly which has given theſe authors, with Newton at their head, the conſiſtence which they place in their reſpective principles and methods: for there are conſiderable differences among them in thoſe reſpects; and each ſeems convinced that the others are in a miſtake. Meſſieurs d'Alembert and De la Grange have greatly corrected the theories of their predeceſſors, and have proceeded on poſtulates which come much nearer to the real ſtate of the caſe. But their inveſtigations involve us in ſuch an inextricable maze of analytical inveſtigation, that even when we are again conducted to the light of day by the clue which they have given us, we can make no uſe of what we there diſcovered.

80
Though imperfect is very uſeful.

But this theory imperfect as it is, is of great ſervice. It generalizes our obſervations and experiments, and enables us to compoſe a *practical doctrine* from a heap of facts which otherwiſe muſt have remained ſolitary and unconnected, and as cumberſome in their application as the characters of the Chineſe writing.

81
Fundamental propoſition.

The fundamental propoſition of this practical hydrodynamics is, that water or any fluid contained in an open veſſel of indefinite magnitude, and impelled by its weight only, will flow through a ſmall orifice with the velocity which a heavy body would acquire by falling from the horizontal ſurface of the fluid. Thus, if the orifice is 16 feet under the ſurface of the water, it will iſſue with the velocity of 32 feet in a ſecond.

Its velocity correſponding to any other depth h of the orifice under the ſurface, will be had by this eaſy proportion: "As the ſquare root of 16 is to the ſquare root of h; ſo is 32 feet to the velocity required: or, alternately, $\surd 16 : 32 = \surd h ; v$, and $v = \frac{32\surd h}{\surd 16} =$, $\frac{32}{4}\surd h, = 8\surd h$: that is multiply the ſquare root of the height in feet by eight, and the product is the required velocity.

On the other hand, it frequently occurs, that we want to diſcover the depth under the ſurface which will produce a known velocity v. Therefore $\surd h = \frac{v}{8}$, and $h = \frac{v^2}{64}$: that is, divide the ſquare of the velocity by 64, and the quotient is the depth wanted in feet.

This propoſition is ſufficient for all our purpoſes. For ſince water is nearly a perfect fluid, and propagates all impreſſions undiminiſhed, we can, in place of any preſſure of a piſton or other cauſe, ſubſtitute a perpendicular column of water whoſe weight is equal to this preſſure, and will therefore produce the ſame efflux.— Thus, if the ſurface of a piſton is half a ſquare foot, and it be preſſed down with the weight of 500 pounds, and we would wiſh to know with what velocity it would cauſe the water to flow through a ſmall hole, we know that a column of water of this weight, and of half a foot baſe, would be 16 feet high. And this propoſition teaches us, that a veſſel of this depth will have a velocity of efflux equal to 32 feet in a ſecond.

82
Its utility.

If therefore our preſſing power be of ſuch a kind that it can continue to preſs forward the piſton with the force of 500 pounds, the water will flow with this velocity, whatever be the ſize of the hole. All that remains is, to determine what change of *actual preſſure* on the piſton reſults from the motion of the piſton itſelf, and to change the velocity of efflux in the ſubduplicate ratio of the change of actual preſſure.

83
Remark previous to its application.

But before we can apply this knowledge to the circumſtances which take place in the motion of water in pumps, we muſt take notice of an important modification of the fundamental propoſition, which is but very obſcurely pointed out by any good theory, but is eſtabliſhed on the moſt regular and unexceptionable obſervation.

If the efflux is made through a hole in a thin plate, and the velocity is computed as above, we ſhall diſcover the quantity of water which iſſues in a ſecond by obſerving, that it is a priſm or cylinder of the length indicated by the velocity, and having its tranſverſe ſection equal to that of the orifice. Thus, in the example already given, ſuppoſing the hole to be a ſquare inch, the ſolid contents of this priſm, or the quantity of water iſſuing in a ſecond, is 1 × 32 × 12 cubic inches, or 384 cubic inches. This we can eaſily meaſure by receiving it in a veſſel of known dimenſions. Taking this method, we uniformly find a deficiency of nearly 38 parts in 100; that is, if we ſhould obtain 100 gallons in any number of ſeconds, we ſhall in fact get only 62. This is a moſt regular fact, whether the velocities are great or ſmall, and whatever be the ſize and form of the orifice. The deficiency increaſes indeed in a very minute degree with the velocities. If, for inſtance, the depth of the orifice be one foot, the diſcharge is $\frac{6213}{10000}$; if it be 15 feet, the diſcharge is $\frac{6178}{10000}$.

This deficiency is not owing to a diminution of velocity; for the velocity may be eaſily and accurately meaſured by the diſtance to which the jet will go, if directed horizontally. This is found to correſpond very nearly with the propoſition, making a very ſmall allowance for friction at the border of the hole, and for the reſiſtance of the air. Sir Iſaac Newton aſcribed the deficiency with great juſtice to this, that the lateral columns of water, ſurrounding the column which is incumbent on the orifice, preſs towards the orifice, and contribute to the expence equally with that column. Theſe lateral filaments, therefore, iſſue obliquely, croſſing the motion of the central ſtream, and produce a contraction of the jet; and the whole ſtream does not acquire a parallel motion and its ultimate velocity till it has got to ſome diſtance from the orifice. Careful obſervation ſhowed him that this was really the caſe. But even his genius could not enable him to aſcertain the motion of the lateral filaments by theory, and he was obliged to meaſure every thing as he ſaw it. He found the diameter of the jet at the place of the greateſt contraction to be preciſely ſuch as accounted for the deficiency. His explication has been unanimouſly acquieſced in; and experiments have been multiplied to aſcertain all thoſe circumſtances which our theory cannot determine *á priori*. The moſt complete ſet of experiments are thoſe of Michelotti, made at Turin at the expence of the prince of Piedmont. Here jets were made of 1, 2, 3, and 4 inches diameter; and the water received into ciſterns moſt accurately formed of brick, and lined with ſtucco. It is the reſult of theſe experiments which we have taken for a meaſure of the deficiency.

We may therefore conſider the water as flowing through a hole of this contracted dimenſion, or ſubſtitute this for the real orifice in all calculations. For it is evident that if a mouth-piece (ſo to call it) were made, whoſe internal ſhape preciſely tallied with the form which the jet aſſumes, and if this mouth-piece be applied to the orifice, the water will flow out without any obſtruction. The veſſel may therefore be conſidered as really having this mouth-piece.

Nay, from this we derive a very important obſervation, "that if, inſtead of allowing the water to flow through a hole of an inch area made in a thin plate, we make it flow through a hole in a thick plank, ſo formed that the external orifice ſhall have an inch area, but be widened internally agreeably to the ſhape which nature forms, both the velocity and quantity will be that which the fundamental propoſition determines. Michelotti meaſured with great care the form of the great jets of three and four inches diameter, and found that the bounding curve was an elongated trochoid. He then made a mouth-piece of this form for his jet of one inch, and another for his jet of two inches; and he found the diſcharges to be $\frac{979}{1000}$ and $\frac{987}{1000}$; and he, with juſtice, aſcribed the trifling deficiency which ſtill remained, partly to friction and partly to his not having exactly ſuited his mouth-piece to the natural form. We imagine that this laſt circumſtance was the ſole cauſe: For, in the firſt place, the water in his experiments, before getting at his jet-holes, had to paſs along a tube of eight inches diameter. Now a jet of four inches bears too great a proportion to this pipe; and its narrowneſs undoubtedly hindered the lateral colmuns from contributing to the efflux in their due proportion, and therefore rendered the jet leſs convergent. And, in the next place, there can be no doubt (and the obſervations of Daniel Bernoulli confirm it) but that this convergency begins within the veſſel, and perhaps at a very conſiderable diſtance from the orifice. And we imagine, that if accurate obſervations could be made on the motion of the remote lateral particles within the veſſel, and an internal mouth-piece were ſhaped according to the curve which is deſcribed by the remoteſt particle that we can obſerve, the efflux of water would almoſt perfectly tally with the theory. But indeed the coincidence is already ſufficiently near for giving us very valuable information. We learn that the quantity of water which flows through a hole, in conſequence of its own weight, or by the action of any force, may be increaſed one half by properly ſhaping the paſſage to this hole; for we ſee that it may be increaſed from 62 to near 99.

But there is another modification of the efflux, which we confeſs our total incapacity to explain. If the water iſſues through a hole made in a plate whoſe thickneſs is about twice the diameter of the hole, or, to expreſs it better, if it iſſues through a pipe whoſe length is about twice its diameter, the quantity diſcharged is nearly $\frac{82}{100}$ of what reſults from the propoſition. If the pipe be longer than this, the quantity is diminiſhed by friction, which increaſes as the length of the pipe increaſes. If the pipe be ſhorter, the water will not fill it, but detaches itſelf at the very entry of the pipe, and flows with a contracted jet. When the pipe is of this length, and the extremity is ſtopped with the finger, ſo that it begins to flow with a full mouth, no ſubſequent contraction is obſerved; but merely ſtriking on the pipe with a key or the knuckle is generally ſufficient to detach the water in an inſtant from the ſides of the pipe, and reduce the efflux to $\frac{62}{100}$.

This effect is moſt unaccountable. It certainly ariſes from the mutual adheſion or attraction between the water and the ſides of the pipe; but how this, acting at right angles to the motion, ſhould produce an increaſe from 62 to 82, nearly $\frac{1}{3}$, we cannot explain. It ſhows, however, the prodigious force of this attraction, which in the ſpace of two or three inches is able to communicate a great velocity to a very great body of water. Indeed the experiments on capillary tubes ſhow that the mutual attraction of the parts of water is ſome thouſands of times greater than their weight.

We have only further to add, that every increaſe of pipe beyond two diameters is accompanied with a diminution of the diſcharge; but in what ratio this is diminiſhed it is very difficult to determine. We ſhall only obſerve at preſent that the diminution is very great. A pipe of 2 inches diameter and 30 feet long has its diſcharge only $\frac{54}{100}$ of what it would be if only 4 inches long. If its length be 60 feet, its diſcharge will be no more than $\frac{39}{100}$. A pipe of 1 inch diameter would have a diſcharge of $\frac{44}{100}$, and $\frac{31}{100}$, in the ſame ſituation. Hence we may conclude that the diſcharge of a 4-inch pipe of 30 feet long will not exced $\frac{1}{3}$ of what it would be if only 8 inches long. This will ſuffice for our preſent purpoſes; and the determination of the velocities and diſcharges in long conduits from pump-machines muſt be referred to the article *Water-Works*. At preſent we ſhall confine our attention to the pump itſelf, and to what will contribute to its improvement.

Before we can proceed to apply this fundamental propoſition to our purpoſe, we muſt anticipate in a looſe way a propoſition of continual uſe in the conſtruction of *Water-Works*.

Let water be ſuppoſed ſtagnant in a veſſel EFGH (fig. 37.), and let it be allowed to flow out by a cylindrical pipe HIKL, divided by any number of partitions B, C, D, &c. Whatever be the areas B, C, D of theſe orifices, the velocity in the intermediate parts of the pipe will be the ſame; for as much paſſes through any one orifice in a ſecond as paſſes through any other in the ſame time, or through any ſection of the intervening pipe. Let this velocity in the pipe be V, and let the area of the pipe be A. The velocity in the orifices B, C, D, muſt be $\frac{VA}{B}$, $\frac{VA}{C}$, $\frac{VA}{D}$, &c. Let g be the velocity acquired in a ſecond by a heavy body. Then, by the general propoſition, the height of water in the veſſel which will produce the velocity $\frac{VA}{B}$ in the firſt orifice alone, is $\frac{V^2A^2}{2gB^2}$. After this paſſage the velocity is again reduced to V in the middle of the ſpace between the firſt and ſecond orifices. In the ſecond orifice this velocity is changed to $\frac{VA}{C}$. This alone would have required a height of water $\frac{V^2A^2}{2gC^2}$. But the water is already moving with the velocity V, which would have reſulted from a height of water in veſſel (which we ſhall, in the language of the art, call the HEAD OF WATER) equal to $\frac{V^2}{2g}$. Therefore there is only required a head of water $\frac{V^2A^2}{2gC^2}-\frac{V^2}{2g}$, or $\frac{V^2}{2g}\times\overline{\frac{A^2}{C^2}-1}$. Therefore the whole height neceſſary for producing the efflux through both orifices, ſo as ſtill to preſerve the velocity V in the intervening pipe, is $\frac{V^2}{2g}\times\overline{\frac{A^2}{B^2}+\frac{A^2}{C^2}-1}$. In like manner the third orifice D would alone require a head of water $\frac{V^2}{2g}\times\overline{\frac{A^2}{D^2}-1}$; and all the three would require a head $\frac{V^2}{2g}\times\overline{\frac{A^2}{B^2}+\frac{A^2}{C}+\frac{A^2}{D^2}-2}$. By this induction may eaſily be ſeen what head is neceſſary for producing the efflux through any number of orifices.

Let the expence or quantity of water diſcharged in an unit of time (ſuppoſe a ſecond) be expreſſed by the ſymbol Q. This is meaſured by the product of the velocity by the area of the orifice, and is therefore $= VA$, or $\frac{VA}{B}\times B$, or $\frac{VA}{C}\times C$, &c. and $V^2=\frac{Q^2}{A^2}$. Therefore we may compute the head of water (which we ſhall expreſs by H) in reference to the quantity of water diſcharged, becauſe this is generally the intereſting circumſtance. In this view we have $H=\frac{Q^2}{2gA}\times\overline{\frac{A^2}{B^2}+\frac{A^2}{C^2}+\frac{A^2}{D^2}-2}$: which ſhows that the head of water neceſſary for producing the diſcharge increaſes in the proportion of the ſquare of the quantity of water which is diſcharged.

84
To determine the motion of water, &c.

Theſe things being premiſed, it is an eaſy matter to determine the motion of water in a pump, and the quantity diſcharged, reſulting from the action of any force on the piſton, or the force which muſt be applied to the piſton in order to produce any required motion or quantity diſcharged. We have only to ſuppoſe that the force employed is the preſſure of a column of water of the diameter of the working barrel; and this is over and above the force which is neceſſary for merely ſupporting the water at the height of the place of delivery. The motion of the water will be the ſame in both caſes.

85
In the ſucking-pump.

Let us, firſt of all, conſider a ſucking-pump. The motion here depends on the preſſure of the air, and will be the ſame as if the pump were lying horizontally, and communicated with a reſervoir, in which is a head of water ſufficient to overcome all the obſtructions to the motion, and produce a velocity of efflux ſuch as we deſire. And here it muſt be noted that there is a limit. No velocity of the piſton can make the water riſe in the ſuction-pipe with a greater velocity than what would be produced by the preſſure of a column of water 33 feet high; that is, about 46 feet *per* ſecond.

Let the velocity of the piſton be V, and the area of the working barrel be A. Then, if the water fills the barrel as faſt as the piſton is drawn up, the diſcharge during the riſe of the piſton, or the number of cubic feet of water *per* ſecond, muſt be $= V \times A$. This is always ſuppoſed, and we have already aſcertained the circumſtances which enſure this to happen. If, therefore, the water arrived with perfect freedom to the piſton, the force neceſſary for giving it this velocity, or for diſcharging the quantity $V \times A$ in a ſecond, would be equal to the weight of the pillar of water whoſe height is $\frac{V^2}{2g}$, and baſe A.

It does not appear at firſt ſight that the force neceſſary for producing this diſcharge has any thing to do with the obſtructions to the aſcent of the water into the pump, becauſe this is produced by the preſſure of the atmoſphere, and it is the action of this preſſure which is meaſured by the head of water neceſſary for producing the internal motion in the pump. But we muſt always recollect that the piſton, before bringing up any water, and ſupporting it at a certain height, was preſſed on both ſides by the atmoſphere. While the air ſupports the column below the piſton, all the preſſure expended in this ſupport is abſtracted from its preſſure on the under part of the piſton, while its upper part ſtill ſupports the whole preſſure. The atmoſphere continues to preſs on the under ſurface of the piſton, through the intermedium of the water in the ſuction-pipe, with the difference of theſe two forces.—Now, while the piſton is drawn up with the velocity V, more of the atmoſpheric preſſure muſt be expended in cauſing the water to follow the piſton; and it is only with the remainder of its whole preſſure that it continues to preſs on the under ſurface of the piſton. Therefore, in order that the piſton may be raiſed with the velocity V, a force muſt be applied to it, over and above the force neceſſary for merely ſupporting the column of water, equal to that part of the atmoſpheric preſſure thus employed; that is, equal to the weight of the head of water neceſſary for forcing the water up through the ſuction-pipe, and producing the velocity V in the working barrel.

Therefore Let B be the area of the mouth of the ſuction-pipe, and C the area of the fixed valve, and let the ſuction-pipe be of equal diameter with the working barrel. The head neceſſary for producing the velocity V on the working barrel is $\frac{V^2}{2g}\left(\frac{A^2}{B^2}+\frac{A^2}{C^2}-1\right)$. If *d* expreſs the denſity of water; that is, if *d* be the number of pounds in a cubic foot of water, then $d\,\mathrm{A}\,\frac{\mathrm{V}^2}{2g}$ will expreſs the weight of a column whoſe baſe is A, and height $\frac{\mathrm{V}^2}{2g}$, all being reckoned in feet. Therefore the force which muſt be applied, when eſtimated in pounds, will be $p, =\frac{d\,\mathrm{AV}^2}{2g}\left(\frac{\mathrm{A}^2}{\mathrm{B}^2}+\frac{\mathrm{A}^2}{\mathrm{C}^2}-1.\right)$

The firſt general obſervation to be made on what has been ſaid is, that the power which muſt be employed to produce the neceſſary motion, in oppoſition to all the obſtacles, is in the proportion of the ſquare of the velocity which we would produce, or the ſquare of the quantity of water we would diſcharge.

We have hitherto proceeded on the ſuppoſition, that there is no contraction of the jet in paſſing through theſe two orifices. This we know would be very far from the truth. We muſt therefore accommodate things to theſe circumſtances, by diminiſhing B and C in the ratio of the contraction, and calling the diminiſhed areas b and c; then we have $p=\frac{\mathrm{A}d\mathrm{V}^2}{2g}\left(\frac{\mathrm{A}^2}{b^2}+\frac{\mathrm{A}^2}{c^2}-1\right)$.

What this diminution may be, depends on the form of the parts. If the fixed valve, and the entry into the pump, are ſimply holes in thin plates, then $b=\frac{62}{100}$ B and $c=\frac{62}{100}$ C. The entry is commonly widened or trumpet-ſhaped, which diminiſhes greatly the contraction: but there are other obſtacles in the way ariſing from the ſtrainer uſually put round it to keep out filth. The valve may have its contraction greatly diminiſhed alſo by its box being made bell-ſhaped internally; nay, even giving it a cylindrical box, in the manner of fig. 33. is better than no box at all, as in fig 5.; for ſuch a cylindrical box will have the unaccountable effect of the ſhort tube, and make $b=\frac{82}{100}$ B, inſtead of $\frac{62}{100}$ B. Thus we ſee that circumſtances ſeemingly very trifling may produce great effects in the performance of a pump. We ſhould have obſerved that the valve itſelf preſents an obſtacle which diminiſhes the motion and requires an increaſe of power; and it would ſeem that in this reſpect the clack or butterfly valve is preferable to the button valve.

Example. Suppoſe the velocity of the piſton to be 2 feet or 24 inches *per* ſecond, and that the two contracted areas are each $\frac{1}{5}$ of the area of the pump, which is not much leſs than what obtains in ordinary pumps. We have $\frac{\mathrm{V}^2}{2g}\left(\frac{\mathrm{A}^2}{b^2}+\frac{\mathrm{A}^2}{c^2}-1\right)=\frac{576}{768}(25+25-1)$ $=36,75$ inches, and the force which we muſt add to what will merely ſupport the column is the weight of a pillar of water incumbent on the piſton, and ſomething more than three feet high. This would be a ſenſible portion of the whole force in raiſing water to ſmall heights.

We have ſuppoſed the ſuction-pipe to be of the ſame diameter with the working barrel; but it is uſual to make it of ſmaller diameter, generally equal to the water way of the fixed valve. This makes a conſiderable change in the force neceſſary to be applied to the piſton. Let a be the area of the ſuction-pipe, the area of the entry being ſtill B; and the equivalent entry without contraction being ſtill b, we have the velocity at the entrance $=\frac{\mathrm{AV}}{b}$, and the producing head of water $=\frac{\mathrm{A}^2}{2g}\frac{\mathrm{V}^2}{b^2}$. After this the velocity is changed to $\frac{\mathrm{AV}}{a}$ in the ſuction-pipe, with which the water arrives at the valve, where it is again changed to $\frac{\mathrm{AV}}{c}$, and requires for this change a head of water equal to $\frac{\mathrm{A}^2\mathrm{V}^2}{2gc^2}$. But the velocity retained in the ſuction-pipe is equivalent to the effect of a head of water $\frac{\mathrm{A}^2\mathrm{V}^2}{2ga^2}$. Therefore the head neceſſary for producing ſuch a current through the fixed valve, that the water may follow the piſton with the velocity V, is $\frac{\mathrm{A}^2\mathrm{V}^2}{2gb^2}+\frac{\mathrm{A}^2\mathrm{V}^2}{2gc^2}-\frac{\mathrm{A}^2\mathrm{V}^2}{2ga^2}$, or $=\frac{\mathrm{V}^2}{2g}\left(\frac{\mathrm{A}^2}{b^2}+\frac{\mathrm{A}^2}{c^2}-\frac{\mathrm{A}^2}{a^2}\right)$. This is evidently leſs than before, becauſe a is leſs than A, and therefore $\frac{\mathrm{A}^2}{a^2}$ is greater than unity, which was the laſt term of the former formula. There is ſome advantage therefore, derived from making the diameter of the ſuction-pipe leſs than that of the working barrel: but this is only becauſe the paſſage of the fixed valve is ſmaller, and the inſpection of the formula plainly points out that the area of the ſuction-pipe ſhould be equal to that of the fixed valve. When it is larger, the water muſt be accelerated in its paſſage through the valve; which is an uſeleſs expence of force, becauſe this velocity is to be immediately reduced to V in the working-barrel. If the foregoing example be computed with a equal to $\frac{1}{4}$ of A, we ſhall find the head H equal to 29 inches inſtead of 37.

But this advantage of a ſmaller ſuction-pipe is in all caſes very moderate; and the pump is always inferior to one of uniform dimenſions throughout, having the orifice at the fixed valve of the ſame area. And if theſe orifices are conſiderably diminiſhed in any proportion, the head neceſſary for overcoming the obſtacles, ſo that the required velocity V may ſtill be produced in the working barrel, is greatly increaſed. If we ſuppoſe the area a $\frac{1}{9}$ of A, which is frequently done in houſe pumps, where the diameter of the ſuction-pipe does ſeldom exceed $\frac{1}{3}$ of that of the working-barrel; and ſuppoſe every thing made in proportion to this, which is alſo uſual, becauſe the unſkilled pump-makers ſtudy a ſymmetry which ſatisfies the eye; we ſhall find that the pump taken as an example will require a head of water = 13 feet and upwards. Beſides, it muſt be obſerved that the friction of the ſuction-pipe itſelf has not been taken into the account. This alone is greater, in moſt caſes, than all the obſtructions we have been ſpeaking of; for if this pipe is three inches diameter, and that of the working-barrel is ſix, which is reckoned a liberal allowance for a ſuction-pipe, and if the fixed valve is 25 feet above the ſurface of the pit-water; the friction of this pipe will amount to one-third of the whole propelling force,

Thus we have enabled the reader to aſcertain the force neceſſary for producing any required diſcharge of water from a pump of known dimenſions: and the converſe of this determination gives us the diſcharge which will be produced by any given force. For making $\frac{\mathrm{A}^2}{b^2}+\frac{\mathrm{A}^2}{c^2}-\frac{\mathrm{A}^2}{a^2}$, (which is a known quantity, reſulting from the dimenſions of the pump) = M, we have

have $H = \frac{V^2}{2g} M$, and $V^2 = \frac{2gH}{M}$, and $V = \sqrt{\frac{2gH}{M}}$. Now H is that part of the natural power which we have at command which exceeds what is neceſſary for merely ſupporting the column of water. Thus, if we have a pump whoſe piſton has an area of $\frac{1}{4}$ of a ſquare foot, its diameter being $6\frac{3}{4}$ inches; and we have to raiſe the water 32 feet, and can apply a power of 525 pounds to the piſton; we wiſh to know at what rate the piſton will be moved, and the quantity of water diſcharged? Merely to ſupport the column of water of this height and diameter, requires 500 pounds. Therefore the remaining power, which is to produce the motion, is 25 pounds. This is the weight of a column 1 foot 4 inches high, and $H = 1{,}333$ feet. Let us ſuppoſe the diameter of the ſuction-pipe $\frac{1}{2}$ of that of the working-barrel, ſo that $\frac{A}{B} = 4$. We may ſuppoſe it executed in the beſt manner, having its lower extremity trumpet-ſhaped, formed by the revolution of the proper trochoid. The contraction at the entry may therefore be conſidered as nothing, and $\frac{A}{b} = 4$, and $\frac{A^2}{b^2} = 16$. We may alſo ſuppoſe the orifice of the fixed valve equal to the area of the ſuction-pipe, ſo that $\frac{A^2}{C^2}$ is alſo $= 16$, and there is no contraction here; and therefore $\frac{A^2}{c^2}$ is alſo 16. And laſtly, $\frac{A^2}{a^2}$ is alſo 16. Therefore $\frac{A^2}{b^2} + \frac{A^2}{c^2} - \frac{A^2}{a^2}$ or M, $= 16 + 16 - 16, = 16$. We have alſo $2g = 64$. Now $V = \sqrt{\frac{2gH}{M}} = \sqrt{\frac{64 \times 1{,}333}{16}}, = 2{,}309$ feet, and the piſton will move with the velocity of 2 feet 4 inches nearly. Its velocity will be leſs than this, on account both of the friction of the piſton and the friction of the water in the ſuction-pipe. Theſe two circumſtanccs will probably reduce it to one foot eight inches; and it can hardly be leſs than this.

We have taken no notice of the friction of the water in the working-barrel, or in the ſpace above the piſton; becauſe it is in all caſes quite inſignificant. The longeſt pipes employed in our deep mines do not require more than a few inches of head to overcome it.

But there is another circumſtance which muſt not be omitted. This is the reſiſtance given to the piſton in its deſcent. The piſtons of an engine for drawing water from deep mines muſt deſcend again by their own weight in order to repeat their ſtroke. This muſt require a preponderance on that end of the working-beam to which they are attached, and this muſt be overcome by the moving power during the effective ſtroke. It makes, therefore, part of the whole work to be done, and muſt be added to the weight of the column of water which muſt be raiſed.

This is very eaſily aſcertained. Let the velocity of the piſton in its deſcent be V, the area of the pump-barrel A, and the area of the piſton-valve *a*. It is evident, that while the piſton deſcends with the velocity V, the water which is diſplaced by the piſton in a ſecond is $(A-a)V$. This muſt paſs through the hole of the piſton, in order to occupy the ſpace above, which is left by the piſton. If there were no contraction, the water would go thro' with the velocity $\frac{A-a}{a} V$; but as there will always be ſome contraction, let the diminiſhed area of the hole (to be diſcovered by experiment) be *b*; the velocity therefore will be $V \frac{A-a}{b}$. This requires for its production a head of water $\frac{V^2}{2g}\left(\frac{A-a}{b}\right)^2$. This is the height of a column of water whoſe baſe is not A but A—*a*. Calling the denſity of water *d*, we have for the weight of this column, and the force *p* is $d \times \overline{A-a} \times \left(\frac{A-a}{b}\right)^2 \times \frac{V^2}{2g}, = \frac{dV^2 (A-a)^3}{2gb^2}$. This we ſee again, is proportional to the ſquare of the velocity of the piſton in its deſcent, and has no relation to the height to which the water is raiſed.

If the piſton has a button valve, its ſurface is at leaſt equal to *a*; and therefore the preſſure is exerted on the water by the whole ſurface of the piſton. In this caſe we ſhall have $p = \frac{dV^2 A^3}{2gb^2}$ conſiderably greater than before. We cannot aſcertain this value with great preciſion, becauſe it is extremely difficult, if poſſible, to determine the reſiſtance in ſo complicated a caſe. But the formula is exact, if *b* can be given exactly; and we know within very moderate limits what it may amount to. In a pump of the very beſt conſtruction, with a button valve, *b* cannot exceed one-half of A; and therefore $\frac{A^3}{b^2}$ cannot be leſs than 8. In this caſe, $\frac{V^2 A^3}{2gb^2}$ will be $\frac{V^2}{8}$. In a good ſteam-engine pump V is about three feet per ſecond, and $\frac{V^2}{8}$ is about $1\frac{1}{8}$ feet, which is but a ſmall matter.

86
And in th
forcing-pump.

We have hitherto been conſidering the ſucking-pump alone: but the forcing pump is of more importance, and apparently more difficult of inveſtigation.—Here we have to overcome the obſtruction in long pipes, with many bends, contractions, and other obſtructions. But the conſideration of what relates merely to the pump is abundantly ſimple. In moſt caſes we have only to force the water in an air-veſſel, in oppoſition to the elaſticity of the air compreſſed in it, and to ſend it thither with a certain velocity, regulated by the quantity of water diſcharged in a given time. The elaſticity of the air in the air-veſſel propels it along the *Main*. We are not now ſpeaking of the force neceſſary for counterbalancing this preſſure of the air in the air-veſſel, *which is equivalent to all the ſubſequent obſtructions*, but only of the force neceſſary for propelling the water out of the pump with the proper velocity.

We have in a manner determined this already. The piſton is ſolid, and the water which it forces has to paſs through a valve in the lateral pipe, and then to move in the direction of the Main. The change of direction requires an addition of force to what is neceſſary for merely impelling the water through the valve. Its quantity is not eaſily determined by any theory, and it varies according to the abruptneſs of the turn. It appears from experiment, that when a pipe is bent to a right angle, without any curvature or rounding, the velocity is diminiſhed about $\frac{1}{18}$. This would augment

ment the head of water about $\frac{1}{9}$. This may be added to the contraction of the valve hole. Let c be its natural area, and whatever is the contraction competent to its form increaſe it $\frac{1}{18}$, and call the contracted area c. Then this will require a head of water $= \frac{V^2 A^2}{2 g c^2}$. This muſt be added to the head $\frac{V^2}{2g}$, neceſſary for merely giving the velocity V to the water. Therefore the whole is $\frac{V^2}{2g}\left(\frac{A^2}{c^2} + 1\right)$; and the power p neceſſary for this purpoſe is $\frac{d A V^2}{2 g}\left(\frac{A^2}{c^2} + 1\right)$.

It cannot eſcape the obſervation of the reader, that in all theſe formulæ, expreſſing the height of the column of water which would produce the velocity V in the working barrel of the pump, the quantity which multiplies the conſtant factor $\frac{d A V^2}{2 g}$ depends on the contracted paſſages which are in different parts of the pump, and increaſes in the duplicate proportion of the ſum of thoſe contractions. It is therefore of the utmoſt conſequence to avoid all ſuch, and to make the Main which leads from the forcing-pump equal to the working barrel. If it be only of half the diameter, it has but one-fourth of the area, the velocity in the Main is four times greater than that of the piſton, and the force neceſſary for diſcharging the ſame quantity of water is 16 times greater.

It is not, however, poſſible to avoid theſe contractions altogether, without making the main pipe wider than the barrel. For if only ſo wide, with an entry of the ſame ſize, the valve makes a conſiderable obſtruction. Unſkilful engineers endeavour to obviate this by making an enlargement in that part of the Main which contains the valve. This is ſeen in fig. 14. at the valve L. If this be not done with great judgment, it will increaſe the obſtructions. For if this enlargement is full of water, the water muſt move in the direction of its axis with a diminiſhed velocity; and when it comes into the main, it muſt again be accelerated. In ſhort, any abrupt enlargement which is to be afterwards contracted, does as much harm as a contraction, unleſs it be ſo ſhort that the water in the axis keeps its velocity till it reaches the contraction. Nothing would do more ſervice to an artiſt, who is not well founded in the theory of hydrodynamics, than to make a few ſimple and cheap experiments with a veſſel like that of fig. 37. Let the horizontal pipe be about three inches diameter, and made in joints which can be added to each other. Let the joints be about ſix inches long, and the holes from one-fourth to a whole inch in diameter. Fill the veſſel with water, and obſerve the time of its ſinking three or four inches. Each joint ſhould have a ſmall hole in its upper ſide to let out the air; and when the water runs out by it, let it be ſtopped by a peg. He will ſee that the larger the pipe is in proportion to the orifices made in the partitions, the efflux is *more diminiſhed*. We believe that no perſon would ſuſpect this who has not conſidered the ſubject minutely.

87 Uſe of experiments.

All angular enlargements, all boxes, into which the pipes from different working barrels, unite their water before it goes into a Main, muſt therefore be avoided by an artiſt who would execute a good machine; and the different contractions which are unavoidable at the ſeats of valves and the perforations of piſtons, &c. ſhould be diminiſhed by giving the parts a trumpet-ſhape.

In the air-veſſels repreſented in fig. 13. this is of very great conſequence. The throat O, through which the water is forced by the expanſion of the confined air, ſhould always be formed in this manner. For it is this which produces the motion during the returning part of the ſtroke in the pump conſtructed like fig. 13. n° 1. and during the whole ſtroke in n° 2. Neglecting this ſeemingly trifling circumſtance will diminiſh the performance at leaſt one-fifth. The conſtruction of n° 1. is the beſt, for it is hardly poſſible to make the paſſage of the other ſo free from the effects of contraction. The motion of the water during the returning ſtroke is very much contorted.

88 Acceleration of the motion of water in pumps.

There is one circumſtance that we have not taken any notice of, *viz*. the gradual acceleration of the motion of water in pumps. When a force is applied to the piſton, it does not in an inſtant communicate all the velocity which it acquires. It acts as gravity acts on heavy bodies; and if the reſiſtances remained the ſame, it would produce, like gravity, an uniformly accelerated motion. But we have ſeen that the reſiſtances (which are always meaſured by the force which juſt overcomes them) increaſe as the ſquare of the velocity increaſes. They therefore quickly balance the action of the moving power, and the motion becomes uniform, in a time ſo ſhort that we commit no error of any conſequence by ſuppoſing it uniform from the beginning. It would have prodigiouſly embarraſſed our inveſtigations to have introduced this circumſtance; and it is a matter of mere ſpeculative curioſity: for moſt of our moving powers are unequal in their exertions, and theſe exertions are regulated by other laws. The preſſure on a piſton moved by a crank is as variable as its velocity, and in moſt caſes is nearly in the inverſe proportion of its velocity, as any mechanician will readily diſcover. The only caſe in which we could conſider this matter with any degree of comprehenſibility is that of a ſteam-engine, or of a piſton which forces by means of a weight lying on it. In both, the velocity becomes uniform in a very ſmall fraction of a ſecond.

89 Deficiency of elementary books on this ſubject.

We have been very minute on this ſubject. For although it is the only view of a pump which is of any importance, it is hardly ever underſtood even by profeſſed engineers. And this is not peculiar to hydraulics, but is ſeen in all the branches of practical mechanics. The elementary knowledge to be met with in ſuch books as are generally peruſed by them, goes no farther than to ſtate the forces which are in equilibrio by the intervention of a machine, or the proportion of the parts of a machine which will ſet two known forces in equilibrio. But when this equilibrium is deſtroyed by the ſuperiority of one of the forces, the machine muſt move; and the only intereſting queſtion is, *what will be the motion?* Till this is anſwered with ſome preciſion, we have learned nothing of any importance. Few engineers are able to anſwer this queſtion even in the ſimpleſt caſes; and they cannot, from any confident ſcience, ſay what will be the performance of an untried machine. They gueſs at it with a ſucceſs proportioned to the multiplicity of their experience and their own ſagacity. Yet this part of mechanics is as ſuſceptible of accurate computation as the caſes of equilibrium.—We therefore thought it our duty to point out the manner of proceeding ſo circumſtantially, that every ſtep ſhould be plain and eaſy, and that conviction ſhould always accompany our progreſs. This we think it has been in our power to do, by the very ſimple method of ſubſtituting a column of water acting by its weight in lieu of any natural power which we may chance to employ.

To ſuch as wiſh to proſecute the ſtudy of this important part of hydraulics in its moſt abſtruſe parts, we recommend the peruſal of the diſſertations of Mr Pitot and Mr Boſſut, in the Memoirs of the Academy of Paris; alſo the diſſertations of the Chevalier De la Borda, 1766 and 1767; alſo the *Hydraulique* of the Chevalier De Buat. We ſhall have occaſion to conſider the motion of the water in the mains of forcing or lifting pumps which ſend the water to a diſtance, in the article *Water-Works*; where the reader will ſee how ſmall is the performance of all hydraulic machines, in compariſon of what the uſual theories, founded on equilibrium only, would make him expect.

PUN, or Punn, an expreſſion where a word has at once different meanings. The practice of punning is the miſerable refuge of thoſe who wiſh to paſs for wits, without having a grain of wit in their compoſition.—James the I. of England delighted in punning; and the taſte of the ſovereign was ſtudied by the courtiers, and even by the clergy. Hence the ſermons of that age abound with this ſpecies of falſe wit. It continued to be more or leſs faſhionable till the reign of Queen Anne, when Addiſon, Swift, Pope, and Arbuthnot, with the other real wits of that claſſical age, united their efforts to baniſh punning from polite compoſition. It is ſtill admitted ſparingly in converſation; and no one will deny that a happy pun, when it comes unſought, contributes to excite mirth in a company. A profeſſed *punſter*, however, who is always pouring forth his ſenſeleſs quibbles, as Sancho Panca poured forth his proverbs, is ſuch an intolerable nuiſance in ſociety, that we do not wonder at Pope or Swift having written a pamphlet with the title of *God's Revenge againſt Punning*.

PUNCH, an inſtrument of iron or ſteel, uſed in ſeveral arts, for the piercing or ſtamping holes in plates of metals, &c. being ſo contrived as not only to perforate, but to cut out and take away the piece. The punch is a principal inſtrument of the metal-button makers, ſhoe-makers, &c.

Punch is alſo a name for a ſort of compound drink, much uſed here, and in many parts abroad, particularly in Jamaica, and ſeveral other parts of the Weſt-Indies.

Its baſis is ſpring water; which being rendered cooler, briſker, and more acid, with lemon or lime juice, and ſweetened again to the palate with fine ſugar, makes what they call *ſherbet*; to which a proper quantity of ſpirituous liquor, as brandy, rum, or arrack, being added, the liquor becomes punch.

PUNCHEON, Punchin, or *Punchion*, a little block or piece of ſteel, on one end whereof is ſome figure, letter, or mark, engraven either in creux or relievo, impreſſions whereof are taken on metal, or ſome other matter, by ſtriking it with a hammer on the end not engraved. There are various kinds of theſe puncheons uſed in the mechanical arts; ſuch, for inſtance, are thoſe of the goldſmiths, cutlers, pewterers, &c.

The puncheon, in coining, is a piece of iron ſteeled, whereon the engraver has cut in relievo, the ſeveral figures, arms, effigy, inſcription, &c. that there are to be in the matrices, wherewith the ſpecies are to be marked. Minters diſtinguiſh three kinds of puncheons, according to the three kinds of matrices to be made; that of the effigy, that of the croſs or arms, and that of the legend or inſcription. The firſt includes the whole portrait in relievo; the ſecond are ſmall, ſuch only containing a piece of the croſs or arms; for inſtance, a fleur-de-lis, an harp, a coronet, &c. by the aſſemblage of all which the entire matrice is formed. The puncheons of the legend only contain each one letter, and ſerve equally for the legend on the effigy ſide and the croſs ſide. See the article Coinage.

For the puncheons uſed in ſtamping the matrices wherein the types of printing characters are caſt, ſee *Letter-Foundery*.

Puncheon is alſo uſed for ſeveral iron tools, of various ſizes and figures, uſed by the engravers en creux on metals. Seal-gravers particularly uſe a great number for the ſeveral pieces of arms, &c. to be engraven, and many ſtamp the whole ſeal from a ſingle puncheon.

Puncheon, is alſo a common name for all thoſe iron inſtruments uſed by ſtone-cutters, ſculptors, blackſmiths, &c. for the cutting, inciding, or piercing their ſeveral matters.

Thoſe of ſculptors and ſtatuaries ſerve for the repairing of ſtatues when taken out of the moulds. The lockſmiths uſe the greateſt variety of puncheons; ſome for piercing hot, others for piercing cold; ſome flat, ſome ſquare, ſome round, others oval, each to pierce holes of its reſpective figure in the ſeveral parts of locks.

Puncheon, in carpentry, is a piece of timber placed upright between two poſts, whoſe bearing is too great; ſerving, together with them, to ſuſtain ſome large weights.

This term is alſo uſed for a piece of timber raiſed upright, under the ridge of a building, wherein the legs of a couple, &c. are jointed.

Puncheon, is alſo the name of a meaſure for liquids. Rum is brought from the Weſt Indies in puncheons, which are large caſks containing about 130 gallons.

PUNCTUATION, in grammar, the art of pointing, or of dividing a diſcourſe into periods, by points expreſſing the pauſes to be made therein.

The points uſed are four, viz. the period, colon, ſemi-colon, and comma. See the particular uſe of each under its proper article, Comma, Colon, Period, and Semi-colon.

In the general, we ſhall only here obſerve, that the comma is to diſtinguiſh nouns from nouns, verbs from verbs, and ſuch other parts of a period as are not neceſſarily joined together.—The ſemi-colon ſerves to ſuſpend and ſuſtain the period when too long:—the colon, to add ſome new, ſupernumerary reaſon, or conſequence, to what is already ſaid:—and the period, to cloſe the ſenſe and conſtruction, and releaſe the voice.

Punctuation is a modern art. The ancients were entirely unacquainted with the uſe of our commas, colons, &c. and wrote not only without any diſtinction of members and periods, but alſo without diſtinction of words: which cuſtom, Lipſius obſerves, continued till the hundred and fourth Olympiad; during which time the ſenſe alone divided the diſcourſe.

What within our own knowledge at this day puts this beyond diſpute, is the Alexandrian manuſcript, which is at preſent in the king's library at the Britiſh Muſæum. Whoever examines this, will find, that the whole is written *continuo ductu*, without diſtinction of words or ſentences. How the ancients read their works written in this manner, it is not eaſy to conceive.

After the practice of joining words together ceaſed, notes of diſtinction were placed at the end of every word. In all the editions of the *Faſti Capitolini* theſe points occur. The ſame are to be ſeen on the *Columna Roſtrata*. For want of theſe, we find much confuſion in the *Chronicon Marmoreum*, and the covenant between the Smyrnæans and Magneſians, which are both now at Oxford. In Salmaſius's edition of *Dedicatio ſtatuæ rigillæ Herodis*, the like confuſion occurs, where we find ΔΕΥΡΙΤΕ and Δευρ ιτε.

Of theſe marks of diſtinction, the Walcote inſcription found near Bath may ſerve for a ſpecimen:

IVLIU Sv VITALISv FABRI
CESISv LEGv XXv Vv V
STIPENDIORUMv &c.

After every word here, except at the end of a line, we ſee this mark v. There is an inſcription in Mountfaucon, which has a capital letter laid in an horizontal poſition, by way of interſtitial mark, which makes one apt to think that this way of pointing was ſometimes according to the fancy of the engraver.

P. FERRARIVS HERMES
CAECINIAE ⊣ DIGNAE
CONIVGI ⊣ KARRISSIMAE
NVMERIAE ⊣ &c.

Here we obſerve after the words, a T laid horizontally but not after each word, which proves this to be of a much later age than the former.

Having now conſidered that the preſent uſage of ſtops was unknown to the ancients, we proceed to aſſign the time in which this uſeful improvement of language began.

As it appears not to have taken place while manuſcripts and monumental inſcriptions were the only known methods to convey knowledge, we muſt conclude that it was introduced with the art of printing. The 14th century, to which we are indebted for this invention, did not however, beſtow thoſe appendages we call *ſtops*: whoever will be at the pains to examine the firſt printed books, will diſcover no ſtops of any kind; but arbitrary marks here and there, according to the humour of the printer. In the 15th century, we obſerve their firſt appearance. We find, from the books of this age, that they were not all produced at the ſame time; thoſe we meet with there in uſe, being only the comma, the parentheſis, the interrogation, and the full point. To prove this, we need but look into Bale's Acts of Engliſh Votaries, black-letter, printed 1550. Indeed, in the dedication of this book, which is to Edward VI. we diſcover a colon: but, as this is the only one of the kind throughout the work, it is plain this ſtop was not eſtabliſhed at this time, and ſo warily put in by the printer; or if it was, that it was not in common uſe. Thirty years after this time, in that ſenſible and judicious performance of Sir Thomas Elyot, entitled *The Governour*, imprinted 1580, we ſee the colon as frequently introduced as any other ſtop; but the ſemi-colon and the admiration were ſtill wanting, neither of theſe being viſible in this book. In Hackluyt's voyages, printed 1599, we ſee the firſt inſtance of a ſemi-colon; and, as if the editors did not fully apprehend the propriety of its general admiſſion, it is but ſparingly introduced. The admiration was the laſt ſtop that was invented; and ſeems to have been added to the reſt in a period not ſo far diſtant from our own time.

Thus we ſee that theſe notes of diſtinction came into uſe as learning was gradually advanced and improved; one invention indeed, but enlarged by ſeveral additions.

PUNCTUM SALIENS, in anatomy, the firſt rudiments, of the heart in the formation of the fœtus where a throbbing motion is perceived. This is ſaid to be eaſily obſerved with a microſcope in a brood-egg, wherein, after conception, we ſee a little ſpeck or cloud, in the middle whereof is a ſpot that appears to beat or leap a conſiderable time before the fœtus is formed for hatching. See the article FOETUS, and ANATOMY, p. 741, &c.

Punctum ſtans, a phraſe by which the ſchoolmen vainly attempted to bring within the reach of human comprehenſion the poſitive eternity of God. Thoſe ſubtile reaſoners ſeem to have diſcovered that nothing, which is made up of parts whether continuous or diſcrete, can be abſolutely infinite, and that therefore eternity cannot conſiſt of a boundleſs ſeries of ſucceſſive moments. Yet, as if ſuch a ſeries had always exiſted and were commenſurate in duration with the ſupreme Being, they compared his eternity to one of the moments which compoſe the flux of time arreſted in its courſe; and to this eternal moment they gave the name of *punctum ſtans*, becauſe it was ſuppoſed to ſtand ſtill, whilſt the reſt followed each other in ſucceſſion, all vaniſhing as ſoon as they appeared. We need not waſte time or room in expoſing the abſurdity of this conceit, as we have elſewhere endeavoured, in the beſt manner that we can, to aſcertain the meaning of the words *eternity* and *infinity*, and to ſhow that they cannot be predicated of time or ſpace, of points or moments, whether flowing or ſtanding ſtill. (See METAPHYSICS, Part II. chap. 7. 8. and Part III. chap. 6.)

PUNCTURE, in ſurgery, any wound made by a ſharp-pointed inſtrument.

PUNCTURE, in farriery. See there, § xl. 3.

PUNDITS, or PENDITS, learned Bramins devoted to the ſtudy of the Shanſcrit language, and to the ancient ſcience, laws, and religion of Hindoſtan. See PHILOSOPHY, nº 4—12.

PUNICA, the POMEGRANATE TREE: A genus of the monogynia order, belonging to the icoſandria claſs of plants; and in the natural method ranking under the 36th order, *Pomaceæ*. The calyx is quinquefid ſuperior; there are five petals; the fruit is a multilocular and polyſpermous apple.

Species. 1. The granatum, or common pomegranate, riſes with a tree-ſtem; branching numerouſly all the way from the bottom, growing 18 or 20 feet high; with ſpear-ſhaped, narrow oppoſite leaves; and the branches terminated by moſt beautiful large red flowers, ſucceeded by large roundiſh fruit as big as an orange, having a hard rind filled with ſoft pulp and numerous ſeeds. There is a variety with double flowers, remarkably beautiful; and one with ſtriped flowers. 2. The nana, or dwarf American pomegranate, riſes with a ſhrubby ſtem branching four or five feet high, with narrow ſhort leaves and ſmall red flowers, ſucceeded by ſmall fruit; begins flowering in June and continues till October.

Culture. Both theſe ſpecies are propagated by layers: the young branches are to be choſen for this purpoſe, and autumn is the proper time for laying them. Thoſe of the common ſort may be trained either as half or full ſtandards, or as dwarfs. But thoſe deſigned for walls muſt be managed as directed for peaches.

Uſes. The dried flowers of the double-flowered pomegranate are poſſeſſed of an aſtringent quality; for which reaſon they are recommended in diarrhœas, dyſenteries, &c. where aſtringent medicines are proper. The rind of the fruit is alſo a ſtrong aſtringent, and as ſuch is occaſionally made uſe of.

PUNISHMENT, in law, the penalty which a perſon incurs on the commiſſion of a crime. See the article *CRIME and Puniſhment.*

The ingenuity of men has been much exerted to torment each other; but the following are the puniſhments that have been uſually adopted in the different countries of the world. The capital puniſhments have been beheading, crucifixion, burning, roaſting, drowning, ſcalping, hanging by the neck, the arm, or the leg, ſtarving, ſawing, expoſing to wild beaſts, rending aſunder by horſes drawing oppoſite ways, burying alive, ſhooting, blowing from the mouth of a cannon, compulſory deprivation of ſleep, rolling in a barrel ſtuck with nails pointed inwards, poiſoning, preſſing ſlowly to death by a weight laid on the breaſt, caſting headlong from a rock, tearing out the bowels, pulling to pieces with red-hot pincers, the rack, the wheel, impaling, fleaing alive, &c. &c.

The puniſhments ſhort of death have been, fine, pillory, impriſonment, compulſory labour at the mines, galleys, highways, or correction-houſe; whipping, baſtonading, mutilation by cutting away the ears, the noſe, the tongue, the breaſts of women, the foot, the hand; ſqueezing the marrow from the bones with ſcrews or wedges, caſtration, putting out the eyes, baniſhment, running the gauntlet, drumming, ſhaving off the hair, burning on the hand or forehead, &c.

PUNNING. See PUN.

PUPIL, in the civil law, a boy or girl not yet arrived at the age of puberty; i. e. the boy under 14 years, the girl under 12.

PUPIL is alſo uſed in univerſities, &c. for a youth under the education or diſcipline of any perſon.

PUPIL, in anatomy, a little aperture in the middle of the uvea and iris of the eye, through which the rays of light paſs to the cryſtalline humour, in order to be painted on the retina, and cauſe viſion. See ANATOMY, p. 765, &c.

PURCELL (Henry), a juſtly celebrated maſter of muſic, began early to diſtinguiſh himſelf. As his genius was original, it wanted but little forming; and he roſe to the height of his profeſſion with more eaſe than others paſs through their rudiments. He was made organiſt to Weſtminſter abbey in the latter end of the reign of Charles II. In that of William, he ſet ſeveral ſongs for Dryden's *Amyhytrion* and his *King Arthur*, which were received with juſt applauſe. His notes on his operas were admirably adapted to his words, and ſo echoed to the ſenſe, that the ſounds alone ſeemed capable of exciting thoſe paſſions which they never failed to do in conjunction. His muſic was very different from the Italian. It was entirely Engliſh, and perfectly maſculine. His principal works have been publiſhed under the title of *Orpheus Britannicus*. He died in 1695, in the 37th year of his age; and was interred in Weſtminſter abbey, where a monument is erected to his memory.

PURCHAS (Samuel), an Engliſh divine, famous for compiling a valuable collection of voyages, was born in 1577, at Thackſted in Eſſex. After ſtudying at Cambridge, he obtained the vicarage of Eaſtwood in his native county; but leaving that cure to his brother, he ſettled in London, in order to carry on the great work in which he was engaged. He publiſhed the firſt volume in folio 1613, and the four laſt, 12 years after, under the title of *Purchas his Pilgrimage, or Revelations of the world, and the Religions obſerved in all ages and places.* Meanwhile he was collated to the rectory of St Martin's, Ludgate, in London, and made chaplain to Dr Abbot, archbiſhop of Canterbury. His *Pilgrimage* and the learned Hackluyt's *Voyages*, led the way to all the other collections of that kind, and have been juſtly valued and eſteemed. But unhappily, by his publiſhing, he involved himſelf in debt: however, he did not die in priſon, as ſome have aſſerted; but at his own houſe, about the year 1628.

PURCHASE, in law, the buying or acquiring of lands, &c. with mony, by deed or agreement, and not by deſcent or right of inheritance.

PURCHASE, in the ſea-language, is the ſame as *draw in:* thus, when they ſay, the capſtain purchaſes a-pace, they only mean, it draws in the cable a-pace.

PURE, ſomething free from any admixture of foreign or heterogeneous matters.

PURFLEW, a term in heraldry, expreſſing ermins, peans, or any of the furs, when they compoſe a bordure round a coat of arms: thus they ſay, He beareth gules, a bordure, purflew, vairy; meaning, that the bordure is vairy.

PURGATION, the art of purging, ſcouring, or purifying a thing, by ſeparating, or carrying off any impurities found therein. Thus,

In pharmacy, purgation, is the cleanſing of a medicine by retrenching its ſuperfluities. In chemiſtry, it is uſed for the ſeveral preparations of metals and minerals intended to clear them of their impurities, more uſually called *purification* and *refining*. See REFINING.

In medicine, purgation is an excretory motion ariſing from a quick and orderly contraction of the fleſhy fibres of the ſtomach and inteſtines, whereby the chyle, corrupted humours, and excrements lodged therein, are protruded further and further, and at length quite excluded the body by ſtool. See MATERIA MEDICA.

For the menſtrual purgation of women, ſee MENSES

PURGATION, in law, ſignifies the clearing a perſon's ſelf of a crime of which he is ſuſpected and accuſed before a judge. This purgation is either canonical or vulgar. Canonical purgation is preſcribed by the canon-law, and the form thereof in the ſpiritual court is uſually thus: The perſon ſuſpected takes his oath that he is innocent of the crime charged againſt him; and at the

PUMP.

Plate CCCCXXIV.

Fig. 1.

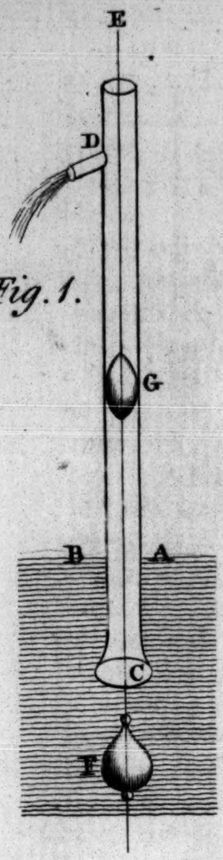

Fig. 2.

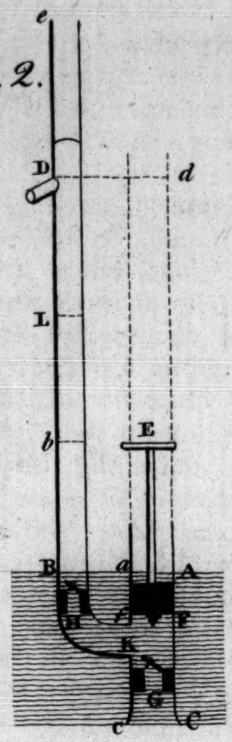
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Fig. 3.

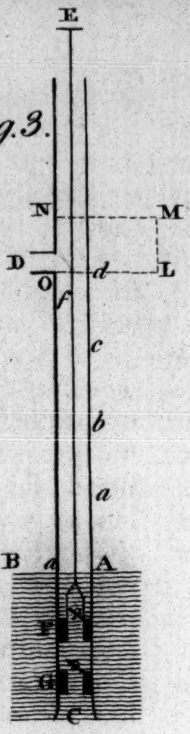
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Fig. 4.

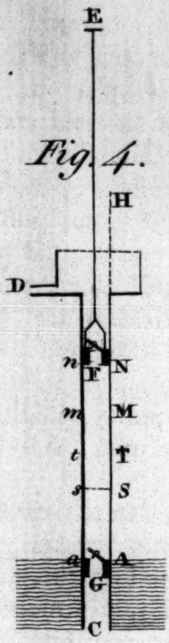
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Fig. 5.

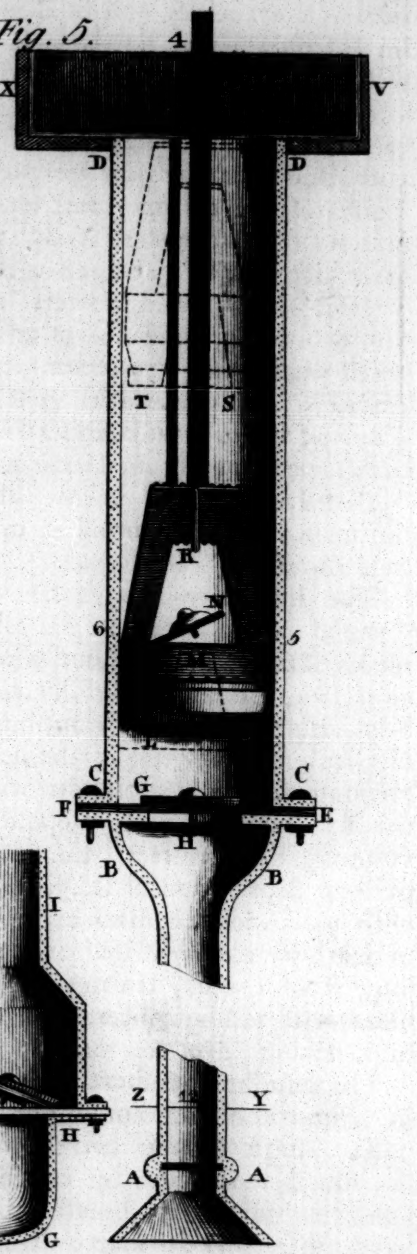
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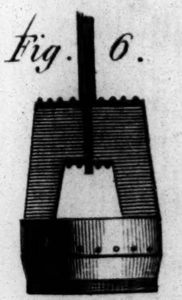
Fig. 6.



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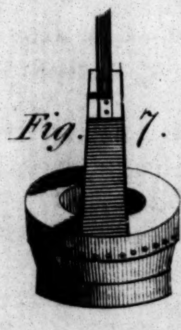

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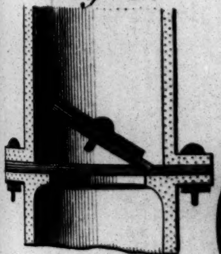

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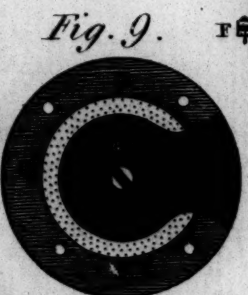

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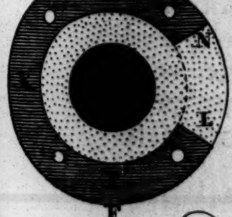

Fig. 11.

Fig. 12.

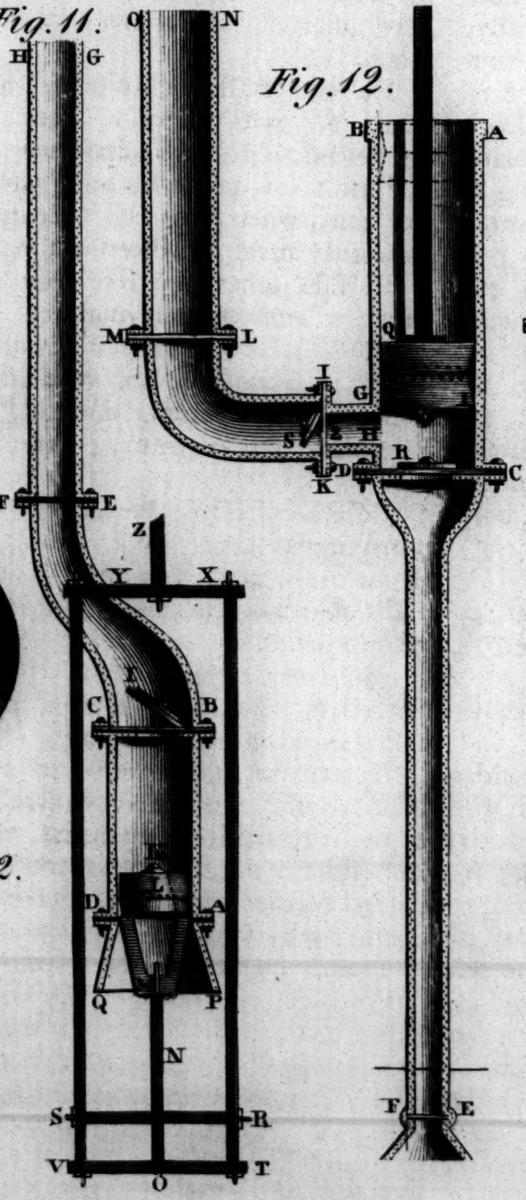
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Fig. 14.

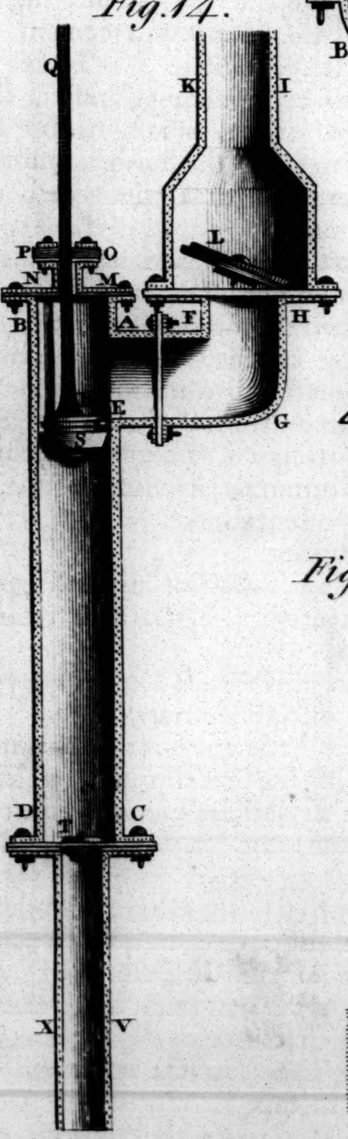
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Fig. 13.

N°1. N°2.

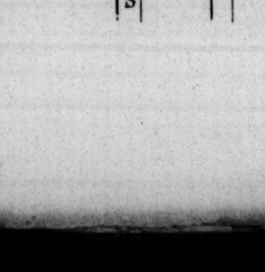
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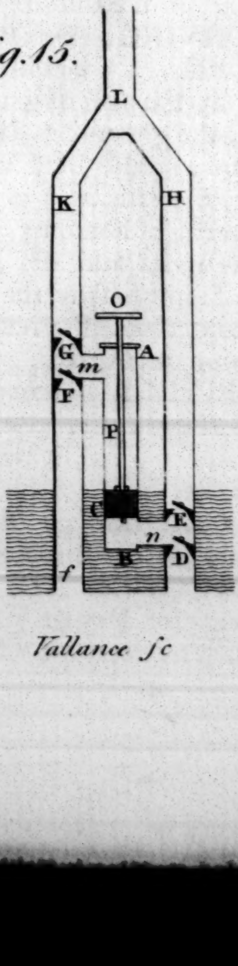
Fig. 15.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Vallance sc

BRITISH MUSEUM

PUMP

Plate CCCCXXV

Fig. 16.

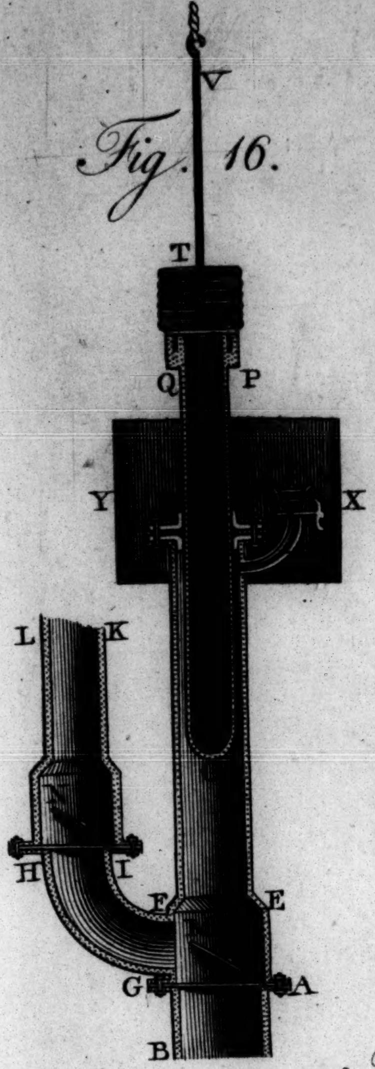
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Fig. 17.

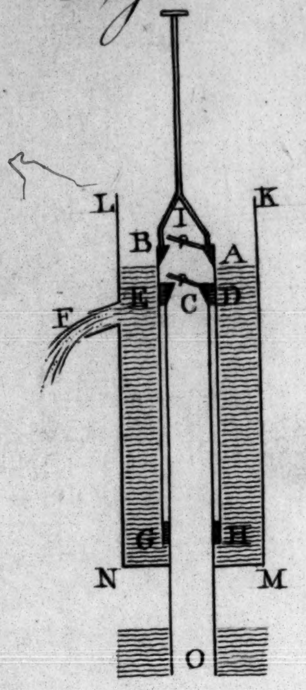
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Fig. 18.

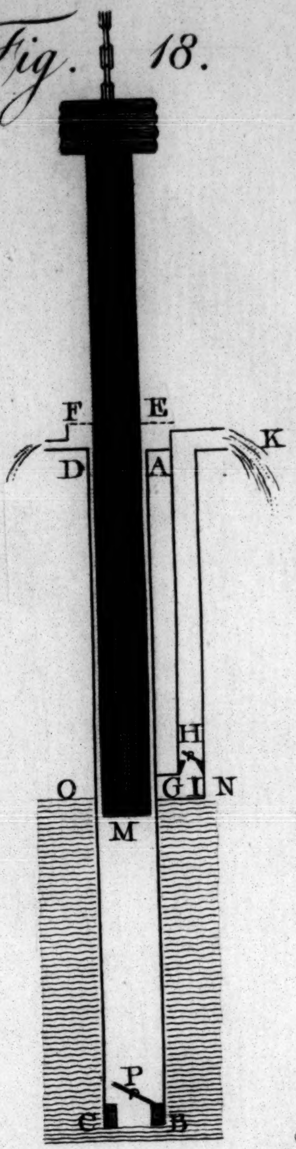
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Fig. 19.

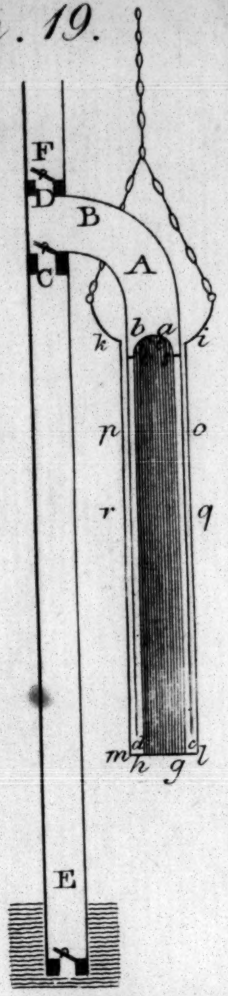
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Fig. 20.

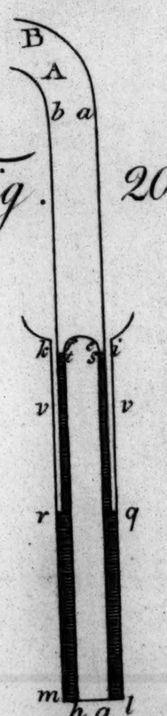
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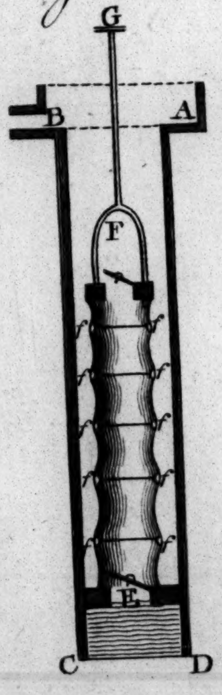
Fig. 21.



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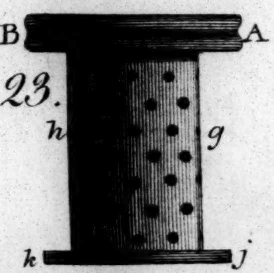

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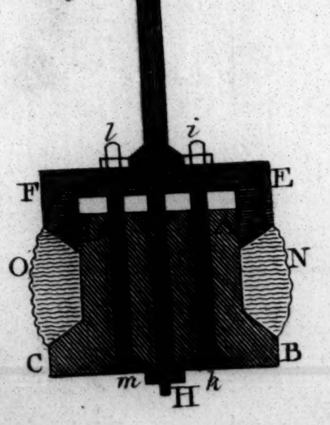
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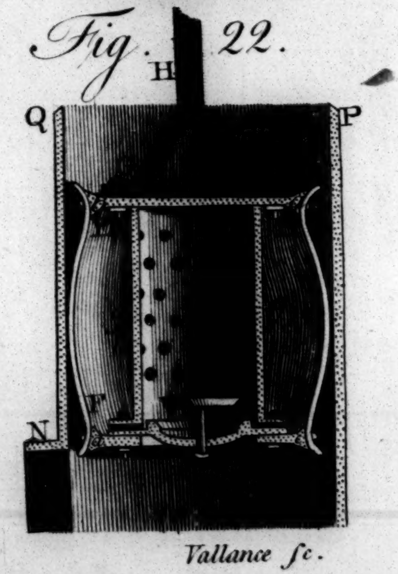
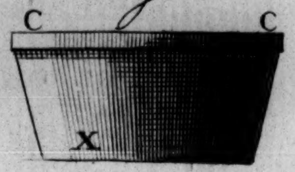
Fig. 22.



Vallance sc.

BRITISH MUSEUM

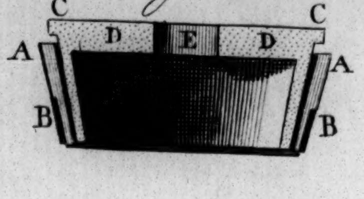
Fig. 25.



PUMP.

Plate CCCCXXVI.

Fig. 26.



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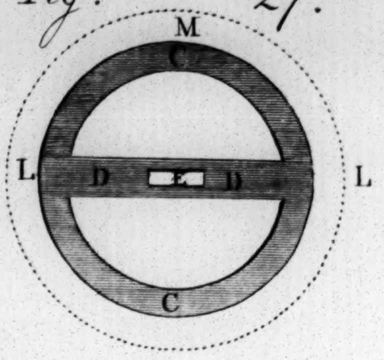

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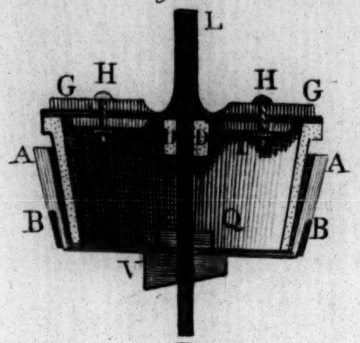
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Fig. 30.

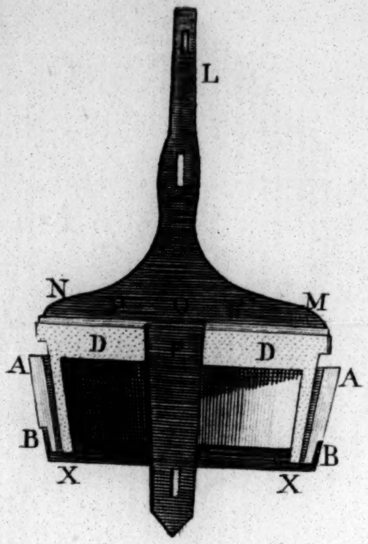
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Fig. 29.

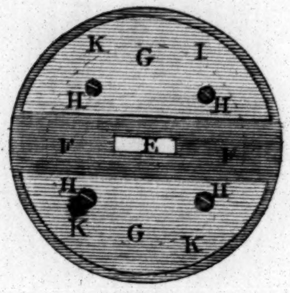
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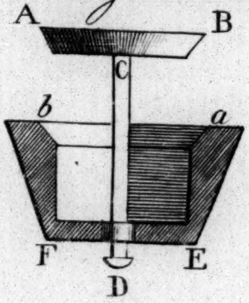
Fig. 34.



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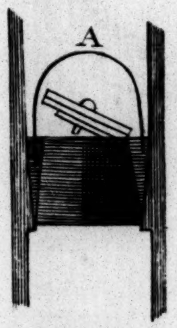

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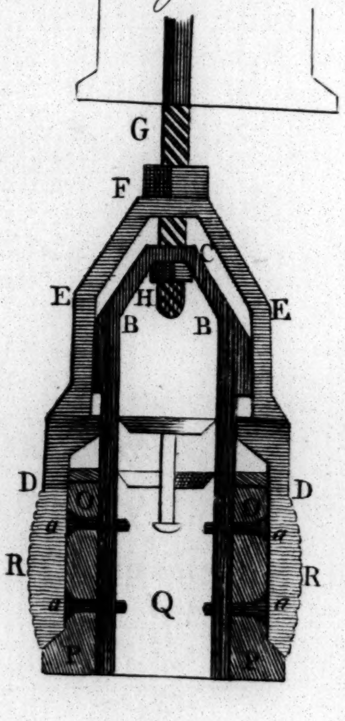
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Fig. 32.

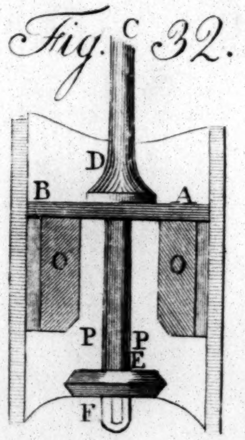
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Fig. 36.

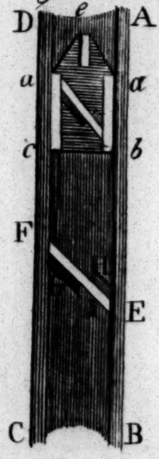
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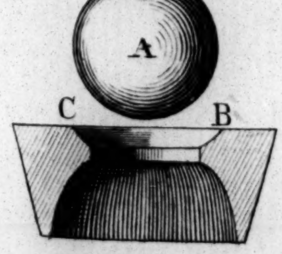
Fig. 32.



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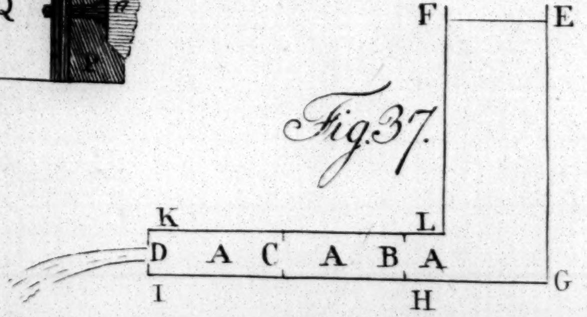
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Trenchard sc.

BRITISH MUSEUM

ſame time brings ſome of his neighbours to make oath that they believe he ſwears truly. Vulgar purgation was anciently by fire or water, or elſe by combat, and was practiſed till aboliſhed by the canons. See Battel *in law*, Ordeal, &c.

PURGATIVE, or *Purging Medicines*, medicaments which evacuate the impurities of the body by ſtool, called alſo *cathartics*.

PURGATORY, a place in which the juſt, who depart out of this life, are ſuppoſed to expiate certain offences which do not merit eternal damnation. Broughton has endeavoured to prove that this notion has been held by Pagans, Jews, and Mahometans, as well as by Chriſtians; and that in the days of the Maccabees the Jews believed that ſin might be expiated by ſacrifices after the death of the ſinner, cannot be queſtioned.

Papiſt miſrepreſented and repreſented.

Much abuſe has been poured upon the church of Rome for her doctrine of purgatory, and many falſe repreſentations have been made of the doctrine itſelf. The following view of it is taken from a work which is conſidered as a ſtandard by the Britiſh Catholics. 1. Every ſin, how ſlight ſoever, though no more than an idle word, as it is an offence to God, deſerves puniſhment from him, and will be puniſhed by him hereafter, if not cancelled by repentance here. 2. Such ſmall ſins do not deſerve eternal puniſhment. 3. Few depart this life ſo pure as to be totally exempt from ſpots of this nature, and from every kind of debt due to God's juſtice. 4. Therefore few will eſcape without ſuffering ſomething from his juſtice for ſuch debts as they have carried with them out of this world; according to that rule of divine juſtice, by which he treats every ſoul hereafter according to its works, and according to the ſtate in which he finds it in death. From theſe propoſitions, which the Papiſt conſiders as ſo many ſelf-evident truths, he infers that there muſt be ſome third place of puniſhment; for, ſince the infinite goodneſs of God can admit nothing into heaven which is not clean and pure from all ſin both great and ſmall; and his infinite juſtice can permit none to receive the reward of bliſs, who as yet are not out of debt, but have ſomething in juſtice to ſuffer; there muſt of neceſſity be ſome place or ſtate, where ſouls, departing this life, pardoned as to the eternal guilt or pain, yet obnoxious to ſome temporal penalty, or with the guilt of ſome venial faults, are purged and purified before their admittance into heaven. And this is what he is taught concerning purgatory. Which, though he knows not where it is, of what nature the pains are, or how long each ſoul is detained there; yet he believes, that thoſe that are in this place, being the living members of Jeſus Chriſt, are relieved by the prayers of their fellow members here on earth, as alſo by alms and maſſes offered up to God for their ſouls. And as for ſuch as have no relations or friends to pray for them, or give alms, or procure maſſes for their relief; they are not neglected by the church, which makes a general commemoration of all the faithful departed in every maſs, and in every one of the canonical hours of the divine office.

Such is the Popiſh doctrine of purgatory, which is built chiefly upon 2 Macc. xii. 43, 44, 45; St Matth. xii. 31, 32; and 1 Cor. iii. 15. By Proteſtants the books of Maccabees are not acknowledged to be inſpired ſcripture; but if they were, the texts referred to would rather prove that there is no ſuch place as purgatory, ſince Judas did not expect the ſouls departed to reap any benefit from his ſin-offering till the reſurrection. Our Saviour, in St Luke, ſpeaks of remiſſion in *this world* and in the world to *come*; but ſurely neither of theſe is purgatory. The world to come is the ſtate after the reſurrection, and the remiſſion ſpoken of is the ſentence of abſolution to be pronounced on the penitent from the ſeat of general judgment. In the obſcure verſe referred to in the epiſtle to the Corinthians, the apoſtle is, by the beſt interpreters, thought to ſpeak of the difficulty with which Chriſtians ſhould be ſaved from the deſtruction of Jeruſalem. Of the ſtate of ſouls departed he cannot well be ſuppoſed to ſpeak, as upon diſembodied ſpirits fire could make no impreſſion. We cannot help, therefore, thinking with the church of England, that "the Romiſh doctrine of purgatory is a fond thing, vainly invented, and grounded on no warranty of ſcripture;" but we muſt confeſs at the ſame time, that it appears to us to be a very harmleſs error, neither hoſtile to virtue nor dangerous to ſociety. See Resurrection.

PURIFICATION, in matters of religion, a ceremony which conſiſts in cleanſing any thing from a ſuppoſed pollution or defilement.

The Pagans, before they ſacrificed, uſually bathed or waſhed themſelves in water; and they were particularly careful to waſh their hands, becauſe with theſe they were to touch the victims conſecrated to the gods. It was alſo cuſtomary to waſh the veſſel with which they made their libations. The Mahometans alſo uſe purifications previous to the duty of prayer; which are alſo of two kinds, either bathing, or only waſhing the face, hands, and feet. The firſt is required only in extraordinary caſes, as after having lain with a woman, touched a dead body, &c. But leſt ſo neceſſary a preparation for their devotions ſhould be omitted, either where water cannot be had, or when it may be of prejudice to a perſon's health, they are allowed in ſuch caſes to make uſe of fine ſand, or duſt inſtead of it; and then they perform this duty by clapping their open hands on the ſand, and paſſing them over the parts, in the ſame manner as if they were dipped in water.

There were alſo many legal purifications among the Hebrews. When a woman was brought to bed of a male child, ſhe was eſteemed impure for 40 days; and when of a female, for 60: at the end of which time ſhe carried a lamb to the door of the temple to be offered for a burnt-offering, and a young pigeon or turtle for a ſin-offering; and by this ceremony ſhe was cleanſed or purified.

PURIM, or *The Feast of Lots*, a ſolemn feſtival of the Jews, inſtituted in memory of the deliverance they received, by means of Mordecai and Eſther, from Haman's wicked attempt to deſtroy them.

PURITAN, a name formerly given in deriſion to the diſſenters from the church of England, on account of the profeſſion to follow the pure word of God, in oppoſition to all traditions and human conſtitutions. It was likewiſe given in the primitive church to the Novatian ſchiſmatics, becauſe they would never admit to communion any one who from dread of death had apoſtatized from the faith.

PURITY, the freedom of any thing from foreign admixture.

Purity of Style. See Oratory, p. 411, &c.

PURLIEU, ſignifies all that ground near any foreſt, which being made foreſt by King Henry II. Richard I. and King John, was afterwards by perambulations and grants of Henry III. ſevered again from the ſame, and made purlieu; that is to ſay, pure and free from the laws of the foreſt.—The word is derived from the French *pur* "pure," and *lieu* "place."

PURLINS, in building, thoſe pieces of timber that lie acroſs the rafters on the inſide, to keep them from ſinking in the middle of their length.

By the act of parliament for rebuilding London, it is provided, that all purlins from 15 feet 6 inches to 18 feet 6 inches long, be in their ſquare 9 inches and 8 inches; and all in length from 18 feet 6 inches to 21 feet 6 inches, be in their ſquare 12 inches and 9 inches.

PURPLE, a colour compoſed of a mixture of red and blue. See *Colour-Making*, n° 29. and Dying, n° 92.

PURPURA, in natural hiſtory. See Murex: where we have given an account of the Tyrian method of dying purple with a liquid extracted from the fiſh. It has been affirmed, however, that no ſuch method was ever practiſed. "At Tyre (ſays Mr Bruce) I engaged two fiſhermen, at the expence of their nets, to drag in thoſe places where they ſaid ſhell-fiſh might be caught, in hopes to have brought out one of the famous purple-fiſh. I did not ſucceed; but in this I was, I believe, as lucky as the old fiſhers had ever been. The purple-fiſh at Tyre ſeems to have been only a concealment of their knowledge of cochineal; as, had they depended upon the fiſh for their dye, if the whole city of Tyre applied to nothing elſe but fiſhing, they would not have coloured 20 yards of cloth in a year."

PURPURE, in heraldry. The colour ſo called, which ſignifies *purple*, is in engraving repreſented by diagonal lines, from the left to the right. See Heraldry, p. 441. and Plate CCXXVII. fig. ii. n° 6.

It may ſerve to denote an adminiſtrator of juſtice, a lawgiver, or a governor equal to a ſovereign: and, according to G. Leigh, if it is compounded with

Or,	it ſignifies	Riches.
Arg.		Quietneſs.
Gul.		Politics.
Az.		Fidelity.
Ver.		Cruelty.
Sab.		Sadneſs.

PURPUREUS. See Convolvulus, n° 3.

PURRE, or Perkin. See Husbandry, n° 238.

PURSER, an officer aboard a man of war, who receives her victuals from the victualler, ſees that it be well ſtowed, and keeps an account of what he every day delivers to the ſteward. He alſo keeps a liſt of the ſhip's company, and ſets down exactly the day of each man's admiſſion, in order to regulate the quantity of proviſions to be delivered out, and that the paymaſter or treaſurer of the navy may iſſue out the deburſements, and pay off the men, according to his book.

PURSLAIN, in botany. See Portulaca.

PURVIEW, a term uſed by ſome lawyers for the body of an act of parliament, or that part which begins with "Be it enacted &c." as contradiſtinguiſhed from the preamble.

PURULENT, in medicine ſomething mixed with, or partaking of, pus or matter,

PUS, in medicine, a white or yellowiſh matter deſigned by nature for the healing and cementing of wounds and ſores.

The origin and formation of pus is as much unknown as that of any other animal fluid. In an inaugural diſſertation publiſhed at Edinburgh by Dr Hendy, the author ſuppoſes pus to be a ſecreted fluid. It has been thought by many, that pus is either a ſediment from ſerum when beginning to putrefy, or that it is the ſame fluid inſpiſſated by the heat of the body. But both theſe opinions are refuted by ſome experiments of our author, which ſhow, that pus is much leſs inclined to putrefaction than ſerum, and the putrefaction of both is haſtened by an addition of ſome of the red part of the blood. Some other experiments were made in order to try whether pus could be artificially produced. A thin piece of lamb's fleſh, applied to an ulcer diſcharging laudable pus, and covered over with lead, did not aſſume the appearance of pus, but became fetid, and was much leſſened. Serum, in its inflammatory and in its ordinary ſtate, and lymph in different ſtates, were applied to the ſame ulcer, which ſtill diſcharged good pus; but none of theſe were converted into pus; on the contrary, they became very putrid.

In oppoſition to theſe arguments of our author, however, it may be alleged, that if pus was a ſecreted fluid, the veſſels by which it was ſecreted would certainly be viſible; but no ſuch thing has ever been obſerved: on the contrary, it is certain that pus cannot be formed unleſs the air is excluded from the wound. Theſe diſputes, however, are of no great conſequence: but in ſome caſes it becomes a matter of real importance to diſtinguiſh pus from mucus; as thus we may be enabled to know whether a cough is conſumptive, or merely catarrhous. See Mucus. Mr Home, in a diſſertation on the properties of pus, in which he avails himſelf of the experiments of Mr Hunter, as delivered in his *Phyſiological Lectures*, ſays, "that the characteriſtic of pus is its being compoſed of globules; and he thinks that the preſence of globules ſeems to depend upon the pus being in a perfect ſtate. It differs from the blood in the colour of the globules; in their not being ſoluble in water, which thoſe of the blood are; and from the fluid in which they ſwim being coagulable by a ſolution of ſal ammoniac, which ſerum is not." Reſpecting the formation of pus, our author adopts the idea ſuggeſted by Mr Hunter, that the veſſels of the part aſſume the nature of a gland, and ſecrete a fluid which becomes pus. Mr Home aſcertains, by experiment, that pus, at its formation, is not globular, but a tranſparent fluid, of a conſiſtence, in ſome ſort, reſembling jelly; and that the globules are formed while lying upon the ſurface of the ſore; requiring, in ſome inſtances, while the influence of the external air is excluded, fifteen minutes for that purpoſe.

PUSTULE, a pimple, or ſmall eruption on the ſkin full of pus; ſuch as the eruptions of the ſmall-pox.

PUTAMINEÆ, (from *putamen* "a ſhell,") the name of the 25th order of Linnæus's fragments of a natural method; conſiſting of a few genera of plants allied in habit, whoſe fleſhy ſeed-veſſels or fruit is frequently covered with a hard woody ſhell. See Botany, p. 462.

PUTEOLI, (Livy, Strabo): a town of Campania;

ſo called either from its wells, there being many hot and cold ſprings thereabouts; or from its ſtench, *putor*, cauſed by ſulphureous exhalations, (Varro, Strabo). It is now called *Puzzuoli*, and is pleaſantly and advantageouſly ſituated for trade. In a very remote age, the Cumeans made it their arſenal and dockyard; and to this naval eſtabliſhment gave the ſublime appellation of *Dicearchia* or *Juſt Power*.

Swinburne's Travels in the two Sicilies.

The Romans were well aware of the utility of this port and took great pains to improve its natural advantages. Nothing remains of their works but a line of piers, built to break the force of a rolling ſea: they are vulgarly called the *bridge of Caligula*, becauſe that madman is ſaid to have marched in triumph from Puzzuoli to Baia on a bridge; but his was a bridge of boats.

The ruins of its ancient edifices are widely ſpread along the adjacent hills and ſhores. An amphitheatre ſtill exiſts entire in moſt of its parts, and the temple of Serapis offers many curious ſubjects of obſervation; half of its buildings are ſtill buried under the earth thrown upon it by volcanical commotions, or accumulated by the crumblings of the hill; the incloſure is ſquare, environed with buildings for prieſts and baths for votaries; in the centre remains a circular platform, with four flights of ſteps up to it, vaſes for fire, a central altar, rings for victims, and other appendages of ſacrifice, entire and not diſplaced; but the columns that held its roof have been removed to the new palace of Caſerta (ſee CASERTA). Behind this round place of worſhip ſtand three pillars without capitals, part of the pronaos of a large temple; they are of cipolline marble, and at the middle of their height are full of holes eaten in them by the file-fiſh*.

The preſent city contains near 10,000 inhabitants, and occupies a ſmall peninſula; the cathedral was a pagan temple, dedicated to the divinities that preſided over commerce and navigation. E. Long. 14. 40. N. Lat. 41. 15.

In the neighbourhood of Puteoli are many relicks of antient grandeur, of which none deſerves more attention than the Campanian way paved with lava, and lined on each ſide with venerable towers, the repoſitories of the dead, which are richly adorned with ſtucco in the inſide. This road was made in a moſt ſolid expenſive manner by order of Domitian, and is frequently the ſubject of encomium in the poems of Statius.

PUTI CARAJA, in botany, is a genus of Indian plants, of which the characters, as given by Sir William Jones in the Aſiatic Reſearches, vol. ii. p. 351. are theſe. The calyx is five-cleft, the corolla has five equal petals, the pericarpium a thorny legumen and two ſeeds, the leaves oval and pinnated, and the ſtem armed. "The ſeeds (ſays the learned Preſident) are very bitter, and perhaps tonic; ſince one of them, bruiſed and given in two dozes, will, as the Hindoos aſſert, cure an intermittent fever."

PUTORIUS, in zoology. See MUSTELA.

PUTREFACTION, one of the natural proceſſes, directly oppoſite to the life of animals and vegetables, by which organized bodies are diſſolved, and reduced to what may be called their *original elements*.

Putrefaction differs from chemical ſolution; becauſe, in the latter, the diſſolved bodies are kept in their ſtate of ſolution by being combined with a certain agent from which they cannot eaſily be ſeparated; but in putrefaction, the agent which diſſolves the body appears not to combine with it in any manner of way, but merely to ſeparate the parts from each other.—It differs alſo from the reſolution of bodies by diſtillation with violent fire; becauſe, in diſtillation new and permanent compounds are formed, but by putrefaction every thing ſeems to be reſolved into ſubſtances much more ſimple and indeſtructible than thoſe which are the reſult of any chemical proceſs.

The bodies moſt liable to putrefaction are thoſe of animals and vegetables, eſpecially when full of juices. Stones, though by the action of the weather they will moulder into duſt, yet ſeem not to be ſubject to any thing like a real putrefaction, as they are not reſolved into any other ſubſtances than ſand, or ſmall duſt, which ſtill preſerves its lapideous nature. In like manner, vegetables of any kind, when deprived of their juices by drying, may be preſerved for many ages without being ſubjected to any thing like a putrefactive proceſs. The ſame holds good with reſpect to animals; the parts of which, by ſimple drying, may be preſerved in a ſound ſtate for a much longer time than they could be without the previous exhalation of their juices.

Putrefaction is generally allowed to be a kind of fermentation, or rather to be the laſt ſtage of that proceſs; which, beginning with the vinous fermentation, goes on through the acetous, to the ſtage of putridity, where it ſtops. It is argued, however, and ſeemingly not without a great deal of reaſon, that if putrefaction is a fermentation, it muſt neceſſarily be a kind diſtinct from either the vinous or acetous; ſince we frequently obſerve that it takes place where neither the vinous nor the acetous ſtages have gone before; of conſequence, it muſt be, in ſome caſes at leaſt, entirely independent of and unconnected with them. In ſeveral other reſpects it differs ſo much from theſe proceſſes, that it ſeems in ſome degree doubtful whether it can with propriety be called a *fermentation* or not. Both the vinous and acetous fermentations are attended with a conſiderable degree of heat: but in the putrefaction of animal matters eſpecially, the heat is for the moſt part ſo ſmall, that we cannot be certain whether there is any degree of it or not produced by the proceſs. In caſes, indeed, where the quantity of corrupting animal matter is very great, ſome heat may be perceived: and accordingly Dr Monro tells us, that he was ſenſible of heat on thruſting his hand into the fleſh of a dead and corrupting whale. But the moſt remarkable difference between the putrefactive fermentation and that of the vinous and acetous kinds is, that the end of both theſe proceſſes is to produce a new and permanent compound; but that of the putrefactive proceſs is not to produce any new form, but to deſtroy, and reſolve one which already exiſts into the original principles from which all things ſeem to proceed. Thus, the vinous fermentation produces ardent ſpirits; the acetous, vinegar: but putrefaction produces nothing but earth, and ſome effluvia, which, though moſt diſagreeable, and even poiſonous to the human body, yet, being imbibed by the earth and vegetable creation, give life to a new race of beings. It is commonly ſuppoſed, indeed, that volatile alkali is a production of the putrefactive proceſs: but this ſeems liable to diſpute. The vapour of pure volatile alkali is not hurtful to the human frame, but that of putrefying ſubſtances is exceedingly ſo; and, excepting in the caſe of urine, the generation of volatile alkali in putrid ſubſtances is very equivocal. This ſubſtance, which produces more alkali than any other, is much leſs offenſive by its putrid fetor than others; and all animal ſubſtances produce a volatile alkali on being expoſed to the action of fire, of quicklime, or of alkaline ſalts. In theſe caſes the volatile alkali is not ſuppoſed to be produced by the quicklime or fixed ſalt, but only to be extricated from a kind of ammoniacal ſalt pre-exiſting in the animal matters; the probability is the ſame in the other caſe, viz. that volatile alkali is not produced, but only extricated, from theſe ſubſtances by putrefaction.

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* Pholas Dactylus, Linn.

The only thing in which the putrefactive fermentation agrees with the other kinds is, that in all the three there is an extrication of fixed air. In the putrefactive proceſs, it has been thought that this eſcape of the fixed air deprives the body of its coheſion: and Dr Macbride has written a treatiſe, in which he endeavours to prove, that fixed air is the very power of coheſion itſelf, and that all bodies when deprived of their fixed air entirely loſe their coheſion. According to this hypotheſis, the cauſe of putrefaction is the eſcape of fixed air: but it is impoſſible to give a reaſon why fixed air after having ſo long remained in a body, and preſerved its coheſion, ſhould of a ſudden begin to fly off without being acted upon by ſomething elſe. To a ſimilar objection the hypotheſis of thoſe is liable, who ſuppoſe putrefaction to be occaſioned by the eſcape of phlogiſton; for phlogiſton is now known to be a chimera: and though it were a reality, it would not fly off without ſomething to carry it off, any more than fixed air. Animalcules have been thought to be the cauſe of putrefaction: but if animal ſubſtances are covered ſo as to exclude the acceſs of flies or other inſects, no ſuch animalcules are to be diſcovered though putrefaction has taken place; and indeed it requires little proof to convince us, that animals are produced in corrupted bodies only becauſe ſuch ſubſtances prove a proper nidus for the eggs of the parent inſects.

To underſtand the true cauſe of putrefaction, we muſt take notice of the circumſtances in which the proceſs goes on moſt rapidly. Theſe are, heat, a little moiſture, and confined air. Extreme cold prevents putrefaction, as well as perfect dryneſs; and a free circulation of air carries off the putrid effluvia; a ſtagnation of which ſeems to be neceſſary for carrying on the proceſs. It ſeems alſo to hold pretty generally, that putrefying bodies ſwell and become ſpecifically lighter; for which reaſon the carcaſes of dead animals, after having ſunk in water, riſe to the top and float. This laſt phenomenon, as has been obſerved under the article BLOOD, n° 29. ſhows that theſe bodies have received a certain quantity of an elaſtic principle from the air, which thus ſwells them up to ſuch a ſize. It may be ſaid indeed, that this increaſe of ſize in putrefying bodies is owing only to the extrication of air within themſelves: but this amounts to the ſame thing; for the air which exiſts internally in the body of any animal, is entirely diveſted of elaſticity while it remains there, and only ſhows its elaſtic properties upon being extricated. The elaſtic principle which combines with the air fixed in the animal ſubſtance, therefore, muſt come from the external atmoſphere; and conſequently the agent in putrefaction muſt be the elaſtic principle of the atmoſphere itſelf, probably the ſame with elementary fire.

But, granting this to be true, it is difficult to ſhow why putrefaction ſhould not take place in a living body as well as in a dead one; ſeeing the one is as much expoſed to the action of the air as the other. This difficulty, however, is not peculiar to the preſent hypotheſis; but will equally occur whatever we may ſuppoſe the cauſe of putrefaction to be. The difficulty ſeems to be a little cleared up by Dr Prieſtley, who ſhows, that, by means of reſpiration, the body is freed from many noxious effluvia which would undoubtedly deſtroy it; and by the retention of which, he thinks, a living body would putrefy as ſoon as a dead one. The way in which reſpiration prevents the putrefaction of the body, is evidently the ſame with that in which the wind prevents fiſh or fleſh hung up in it from becoming putrid. The conſtant inſpiration of the air is like a ſtream of that element continually blown upon the body, and that not only upon its ſurface, but into it; by which means putrefaction is prevented in thoſe parts that are moſt liable to become putrid. On the other hand, the elaſtic principle received from the air by the blood *, by invigorating the powers of life, quickening the circulation, and increaſing perſpiration, enables the body to expel noxious particles from other parts of the body which cannot conveniently be expelled by the lungs.

This leads us to conſider the reaſon why a free expoſure to the air prevents the coming on of putrefaction, or why the confining of the putrid effluvia ſhould be ſo neceſſary in this proceſs. Here it will be proper to recollect, that putrefaction is a ſimple reſolution of the body into earth, air, &c. of which it ſeems originally to have been compoſed. This reſolution is evidently performed by an expanſive power ſeemingly ſituated in every particle of the body. In conſequence of this principle, the body firſt ſwells, then burſts, flies off in vapour, and its particles fall aſunder from each other. The action of the putrefactive proceſs, then, is analogous to that of fire, ſince theſe are the very properties of fire, and the very effects which follow the action of fire upon any combuſtible body. It is therefore exceedingly probable, that the agent in the air, which we have all along conſidered as the cauſe of putrefaction, is no other than fire itſelf; that is, the ethereal fluid expanding itſelf every where, as from a centre to a circumference. The force of the fluid, indeed, is much leſs in putrefaction than in actual ignition; and therefore the effects alſo take place in a much ſmaller degree, and require a much longer time: nevertheleſs, the ſame circumſtances that are neceſſary for keeping up the action of fire, are alſo neceſſary for keeping up the putrefactive proceſs. One of theſe is a free acceſs of air, yet without too violent a blaſt; for as fire cannot burn without air, neither can it endure too much of it: thus a candle goes out if put under a receiver, and the air exhauſted; and it will do the ſame if we blow violently upon it. In like manner, putrefaction requires a certain quantity of air, much leſs indeed than fire: and as it requires leſs to ſupport it, ſo it can alſo endure much leſs air than fire; for a ſtream of air which would not put out a fire, will effectually prevent putrefaction. The cauſe of this in both is the ſame. Fire cannot burn becauſe the vapour is carried off too faſt; and thus the latent heat, which ought to ſupport the flame §, is entirely diſſipated. In like manner putrefaction is as certainly attended with

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* See Blood n° 29.

§ See the article Flame.

an emiſſion of azotic gas as fire is with an emiſſion of flame. Theſe gaſes contain a great quantity of latent heat ‡, or of the expanſive principle already mentioned; and if theſe are carried off with greater rapidity than the heat of the atmoſphere can produce them, the conſequence muſt be, that an oppoſite principle to that which produces putrefaction, namely, a principle of cold, or condenſation, inſtead of expanſion, muſt take place, and the body cannot putrefy. That this muſt be the caſe, is evident from the property which all evaporations have of producing cold ||; and it is well known that a briſk current of air promotes evaporation to a great degree. Hence alſo the reaſon is evident why bodies are preſerved uncorrupted by cold; for thus the action of the expanſive principle is totally overcome and ſuſpended, ſo that none of its effects can be perceived.

Thus we may ſee, that one reaſon why an animal body does not putrefy while alive, is its ventilation, as we may call it, by reſpiration; and another is, the continual acceſſion of new particles, leſs diſpoſed to putrefy than itſelf, by the food and drink which is conſtantly taken in. But if either of theſe ways of preventing the commencement of this proceſs are omitted, then putrefaction will take place as well in a living as in a dead body. Of the truth of this laſt fact we have innumerable inſtances. When air is infected with the putrid effluvia of marſhes, and thus the natural effluvia are not carried off from the human body, but, on the contrary, ſome enter into it which are not natural to it, the moſt putrid diſeaſes are produced. The ſame thing happens from the putrid effluvia of dead bodies. Of this we have a remarkable inſtance in the fever which took place in Germany in the war of 1755: one reaſon of which is ſaid to have been an infection of the air by the vaſt numbers of people killed in battle, to which was added a calm in the atmoſphere for a long time; the putrid effluvia being by this prevented from flying off *. When Mr Holwell with 145 others were impriſoned in the black-hole at Calcutta, after paſſing a night in that diſmal habitation, he found himſelf in a high putrid fever. When ſailors in long voyages are obliged to feed upon putrid aliments; when, thro' ſtormy weather, they are much expoſed to wet; in the one caſe the putreſcent effluvia being kept from flying off, and in the other a greater quantity being thrown into the body than what it naturally contains, the ſcurvy, malignant fevers, &c. make their apearance (A). Neither can theſe diſeaſes be removed without removing every one of the cauſes juſt now mentioned: for as putrid diſeaſes will be the conſequence of confined air, naſtineſs, &c. though the proviſions be ever ſo good; ſo, on the other hand, if the proviſions be bad, the beſt air, and moſt exact cleanlineſs, nay, the beſt medicines in the world, will be of no ſervice; as hath been often obſerved in the ſcurvy.

From this account of the nature, cauſe, and method of preventing putrefaction by means of a current of air, we may eaſily ſee the reaſan why it does not take place in ſome other caſes alſo. Bodies will not putrefy *in vacuo*, becauſe there the atmoſphere has not acceſs to impart its elaſtic principle; and though in the vacuum itſelf the principle we ſpeak of does undoubtedly exiſt, yet its action there is by far too weak to decompoſe the ſtructure of an animal body. In extreme cold, the reaſon why putrefaction does not take place has been already ſhown. If the heat is extremely great, the proceſs of ignition or burning takes place inſtead of putrefaction. If the body is very dry, putrefaction cannot take place, becauſe the texture is too firm to be decompoſed by the weak action of the elaſtic principle. Putrefaction may alſo be prevented by the addition of certain ſubſtances; but they are all of them ſuch as either harden the texture of the body, and thus render it proof againſt the action of the elaſtic fluid, or, by diſſolving its texture entirely, bring it into a ſtate ſimilar to what it would be brought

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‡ See Phlogiſton.

|| See Evaporation, n° 3.

* See Medicine, n° 167.

(A) This aeriform fluid, which is exhaled from animal bodies in a ſtate of putrefaction, acts at certain times more powerfully than at others, and is indeed in one ſtage of the proceſs infinitely more noxious than any other elaſtic fluid yet diſcovered. In the Gentleman's Magazine for Auguſt 1788, Dr St John, informs us, that he knew a Gentleman who, by ſlightly touching the inteſtines of a human body beginning to liberate this corroſive gas, was affected with a violent inflammation, which in a very ſhort ſpace of time extended up almoſt the entire length of his arm, producing an extenſive ulcer of the moſt foul and frightful appearance, which continued for ſeveral months, and reduced him to a miſerable ſtate of emaciation. The ſame writer mentions a celebrated profeſſor who was attacked with a violent inflammation of the nerves and fauces from which he with difficulty recovered, merely by ſtooping for an inſtant over a body which was beginning to give forth this deleterious fluid. Hence he infers, that the ſame gas modified or mixed, or united with others, may be the occaſion of the plague, which has ſo often threatened to annihilate the human ſpecies. It is happy, however, for mankind that this particular ſtage of putrefaction continues but for a few hours; and, what may appear very remarkable, this deſtructive gas is not very diſagreeable in ſmell, and has nothing of that abominable and loathſome fetor produced by dead bodies in a leſs dangerous ſtate of corruption; but has a certain ſmell totally peculiar to itſelf, by which it may be inſtantly diſcovered by any one that ever ſmelled it before. This is an object very worthy the attention of phyſicians: it is both extremely intereſting, and very little known; but at the ſame time it is a ſtudy in the higheſt degree unpleaſant, from the deteſtable ſmell and naſtineſs which attend the putrefaction of animal bodies; and a man muſt be armed with uncommon philanthropy and reſolution to attempt it.

Dr St John thinks it probable that there is a rapid fixation of the baſis of vital air in dead bodies at a certain ſtate of putrefaction on account of the luminous appearance which they ſometimes make, and which exiſts but for a few hours: but whether this luminous appearance takes place in every body, or whether it precedes or follows the exhalations of the corroſive gas abovementioned, he had not, when he wrote his paper, been able to diſcover.

by the utmoſt power of putrefaction, ſo that the proceſs cannot then take place. Thus various kinds of ſalts and acids harden the texture of animal ſubſtances, and thus are ſucceſsfully uſed as antiſeptics. The ſame thing may be ſaid of ardent ſpirits; while oils and gums of various kinds prove antiſeptic by a total excluſion of air, which is neceſſary in ſome degree for carrying on the proceſs of putrefaction. Many vegetables, by the aſtringent qualites they poſſeſs, harden the texture of animal ſubſtances, and thus prove powerfully antiſeptic; while, on the other hand, fixed alkaline ſalts, quic klime, and cauſtic volatile alkali, though they prevent putrefaction, yet they do it by diſſolving the ſubſtances in ſuch a manner that putrefaction could do no more though it had exerted its utmoſt force. There is only one other antiſeptic ſubſtance whoſe effects deſerve to be conſidered, and that is ſugar. This, tho' neither acid nor alkaline, is yet one of the moſt effectual means of preventing putrefaction: and this ſeems to be owing to its great tendency to run into the vinous fermentation, which is totally inconſiſtent with that of putrefaction; and this tendency is ſo great, that it can ſcarce be counteracted by the tendency of animal ſubſtances to putrefy in any circumſtances whatever.

Some kinds of air are remarkably antiſeptic, though this ſubject has not been ſo fully inquired into as could be wiſhed. The moſt powerful of them in this reſpect is the nitrous air; next to it, is fixed air; but the powers of the other airs are not ſo well known. It is probable that the antiſeptic properties of fixed and nitrous air, are owing to their quality of extinguiſhing fire, or at leaſt that the principle is the ſame; but, till the nature of theſe two kinds of air are better known, little can be ſaid with certainty on the ſubject.

Sir John Pringle has made experiments to determine the powers of certain ſubſtances to promote or to prevent putrefaction. From theſe experiments he has formed the following Table, ſhowing the relative antiſeptic powers of the ſaline ſubſtances mentioned. Having found that two drams of beef put in a phial with two ounces of water, and placed in a heat equal to 90° of Fahrenheit's thermometer, became putrid in 14 hours, and that 60 grains of ſea-ſalt preſerved a ſimilar mixture of beef and water more than 30 hours, he made the antiſeptic power of the ſea-ſalt a ſtandard, to which he compared the powers of the other ſalts. The algebraic character + ſignifies, that the ſubſtance to which it is annexed had a greater antiſeptic power than is expreſſed by the numbers:

Sea-ſalt, or the ſtandard	1
Sal-gem	1+
Vitriolated tartar	2
Spiritus Mindereri	2
Soluble tartar	2
Sal diureticus	2+
Crude Sal ammoniac	3
Saline mixture	3
Nitre	4+
Salt of hartſhorn	4+
Salt of wormwood	4+
Borax	12
Salt of amber	20
Alum	30

N. B. The quantities of ſpiritus Mindereri and of the ſaline mixture were ſuch, that each of them contained as much alkaline ſalt as the other neutral ſalts.

Myrrh, aloes, aſafœtida, and terra Japonica, were found to have an antiſeptic power 30 times greater than the ſtandard. Gum ammoniacum and ſagapenum ſhowed little antiſeptic power.

Of all reſinous ſubſtances, camphor was found to reſiſt putrefaction moſt powerfully, Sir John Pringle believes that its antiſeptic power is 300 times greater than that of ſea-ſalt.

Chamomile flowers, Virginian ſnake-root, pepper, ginger, ſaffron, contrayerva root, and galls, were found to be 12 times more antiſeptic than ſea-ſalt.

Infuſions of large quantities of mint, angelica, ground ivy, green tea, red-roſes, common wormwood, muſtard, and horſe-radiſh, and alſo decoctions of poppy-heads, were more antiſeptic than ſea-ſalt.

Decoctions of wheat, barley, and other farinaceous grains, checked the putrefaction by becoming ſour.

Chalk, and other abſorbent powders, accelerated the putrefaction, and reſolved meat into a perfect mucus. The ſame powders prevented an infuſion of farinaceous grains from becoming mucilaginous and ſour.

One dram of ſea-ſalt was found to preſerve two drams of freſh beef in two ounces of water, above 30 hours, uncorrupted, in a heat equal to that of the human body, or above 20 hours longer than meat is preſerved in water without ſalt: but half a dram of ſalt did not preſerve it more than two hours longer than pure water. Twenty-five grains of ſalt had little or no antiſeptic quality. Twenty grains, 15 grains, but eſpecially 10 grains only of ſea-ſalt, were found to accelerate and heighten the putrefaction of two drams of fleſh.—Theſe ſmall quantities of ſea-ſalt did alſo ſoften the fleſh more than pure water.

The ſame learned and ingenious phyſician made experiments to diſcover the effects of mixing vegetable with animal matters.

Two drams of raw beef, as much bread, and an ounce of water, being beat to the conſiſtence of pap, and expoſed to 90° of heat according to Fahrenheit's thermometer began to ferment in a few hours, and continued in fermentation during two days. When it began to ferment and ſwell, the putrefaction had begun; and in a few hours afterwards, the ſmell was offenſive. Next day the putrid ſmell ceaſed, and an acid taſte and ſmell ſucceeded. Fleſh alimentary vegetables as ſpinach, aſparagus, ſcurvy-graſs, produced ſimilar effects as bread on fleſh, but in a weaker degree. From ſeveral other experiments he found, that animal ſubſtances excite the fermentation of vegetable ſubſtances, and that the latter ſubſtances correct the putreſcency of the former.

By adding ſaliva to a ſimilar mixture of fleſh, bread, and water, the fermentation was retarded, moderated, but rendered of twice the uſual duration, and the acid produced at laſt was weaker than when no ſaliva was uſed.

By adding an oily ſubſtance to the common mixture of fleſh, bread, and water, a ſtronger fermentation was produced, which could not be moderated by the quantity of ſaliva uſed in the former experiment, till ſome fixed alkaline ſalt was added; which ſalt was found, without ſaliva, to ſtop ſuddenly very high fermentations.

He did not find that ſmall quantities of the following ſalts, ſal ammoniac, nitre, vitriolated tartar, ſal diureticus, ſalt of hartſhorn, ſalt of wormwood, were ſeptic, as ſmall quantities of ſea-ſalt were.

Sugar was found to reſiſt putrefaction at firſt, as other ſalts do, and alſo to check the putrefaction after it had begun by its own fermentative quality, like bread, and other fermentative vegetables.

Lime-water made ſome ſmall reſiſtance to putrefaction.

Port-wine, ſmall-beer, infuſions of bitter vegetables, of bark, and the juice of antiſcorbutic plants, retarded the fermentation of mixtures of fleſh and bread. But an unſtrained decoction of bark conſiderably increaſed that fermentation.

Crabs-eyes accelerated and increaſed the fermentation of a mixture of fleſh and bread.

Lime-water neither retarded nor haſtened the fermentation of ſuch a mixture: but when the fermentation ceaſed, the liquor was neither putrid nor acid, but ſmelt agreeably.

Fleſh pounded in a mortar was found to ferment ſooner than that which had not been bruiſed.

The tough inflammatory cruſt of blood was found to be moſt putreſcent; next to which the craſſamentum, or red coagulated maſs; and laſtly the ſerum.

Dr Macbride's experiments confirm many of thoſe above related, eſpecially thoſe which ſhow that the fermentation of vegetable ſubſtances is increaſed by a mixture of animal or putreſcent matter; that the putreſcency of the latter is corrected by the fermentative quality of the former; and that the putrefaction and fermentation of mixtures of animal and vegetable ſubſtances were accelerated by additions of abſorbent earths and of Peruvian bark. He alſo found, that although unburnt calcareous earths were ſeptic, quicklime and lime-water prevented putrefaction, but that they deſtroyed or diſſolved the texture of fleſh.

The experiments of the author of the *Eſſai pour ſervir à l'Hiſtoire de la Putrefaction*, ſhow that metallic ſalts, reſinous powders, extracts of bark, and opium, are very powerfully antiſeptic, and that ſalts with earthy baſes are leſs antiſeptic than any other ſalts.

PUTTOCK-SHROUDS. See *Puttock-Shrouds*.

PUTTY, in its popular ſenſe, is a kind of paſte compounded of whiting and lintſeed oil, beaten together to the conſiſtence of a thick dough.

It is uſed by glaziers for the faſtening in the ſquares of glaſs in ſaſh-windows, and by painters for ſtopping up the crevices and clefts in timber and wainſcots, &c.

PUTTY ſometimes alſo denotes the powder of calcined tin, uſed in poliſhing and giving the laſt gloſs to works of iron and ſteel.

TERRA PUZZULANA, or **POZZOLANA**, is a greyiſh kind of earth uſed in Italy for building under water. The beſt is found about Puteoli, Baiæ, and Cumæ, in the kingdom of Naples, from the firſt of which places it derives its name. It is a volcanic product, compoſed of heterogeneous ſubſtances, thrown out from the burning mouths of volcanoes in the form of aſhes; ſometimes in ſuch large quantities, and with ſo great violence, that whole provinces have been covered with it at a conſiderable diſtance. In the year 79 of the common era, the cities of Herculaneum, Pompeia, and Stabia, although at the diſtance of many miles from Veſuvius, were, nevertheleſs, buried under the matters of theſe dreadful eruptions; as Bergman relates in his *Treatiſe of the Volcanic Products*. This volcanic earth is of a grey, brown, or blackiſh colour; of a looſe, granular, or duſty and rough, porous or ſpongy texture, reſembling a clay hardened by fire, and then reduced to a groſs powder. It contains various heterogeneous ſubſtances mixed with it. Its ſpecific gravity is from 2500 to 2800; and it is, in ſome degree, magnetic: it ſcarcely efferveſces with acids, though partially ſoluble in them. It eaſily melts *per ſe*; but its moſt diſtinguiſhed property is, that it hardens very ſuddenly when mixed with $\frac{1}{3}$ of its weight of lime and water; and forms a cement, which is more durable in water than any other.

According to Bergman's Analyſis, 100 parts of it contain from 55 to 60 of ſiliceous earth, 20 of argillaceous, five or ſix of calcareous, and from 15 to 20 of iron. Its effects, however, in cement may perhaps depend only on the iron which has been reduced into a particular ſubſtance by means of ſubterraneous fires; evident ſigns of which are obſervable in the places where it is obtained. If the ſlate in Henneberg, or Kennekulle in the province of Weſtergotland, ſhould happen to get fire, the uppermoſt ſtratum, which now conſiſts of a mixture of iron and different kinds of rocks, called *graberg* in the account given of them, they might perhaps be changed partly into ſlag and partly into *terra puzzolana*.

It is evidently a martial argillaceous marl, that has ſuffered a moderate heat. Its hardening power ariſes from the dry ſtate of the half-baked argillaceous particles, which makes them imbibe water very rapidly, and thus accelerates the deſiccation of the calcareous part; and alſo from the quantity and ſemiphlogiſticated ſtate of the iron contained in it. It is found not only in Italy but in France, in the provinces of Auvergne and Limoges; and alſo in England and elſewhere.

PUZZUOLI. See PUTEOLI.

PYANEPSIA, in antiquity, an Athenian feſtival celebrated on the ſeventh day of the month *Pyanepſion*; which according to the generality of critics, was the ſame with our September.

Plutarch refers the inſtitution of this feaſt to Theſeus, who, after the funeral of his father, on this day paid his vows to Apollo, becauſe the youths who returned with him ſafe from Crete then made their entry into the city. On this occaſion, theſe young men putting all that was left of their proviſions into one kettle, feaſted together on it, and made great rejoicing. Hence was derived the cuſtom of boiling pulſe on this feſtival. The Athenians likewiſe carried about an olive branch, bound about with wool, and crowned with all ſorts of firſt-fruits, to ſignify that ſcarcity and barrenneſs were ceaſed, ſinging in proceſſion a ſong. And when the ſolemnity was over, it was uſual to erect the olive-branch before their doors, as a preſervative againſt ſcarcity and want.

PYCNOSTYLE, in the ancient architecture, is a building where the columns ſtand very cloſe to each other; only one diameter and a half of the column being allowed for the intercolumniations.

According to Mr Evelyn, the pycnoſtyle chiefly belonged to the compoſite order, and was uſed in the moſt magnificent buildings; as at preſent in the periſtyle at St Peter's at Rome, which conſiſts of near 300 columns;

lumns; and in ſuch as yet remain of the ancients, among the ruins of Palmyra.

PYGARGUS, in ornithology, a ſpecies of Falco.

PYGMALION, in fabulous hiſtory, a king of Cyprus, who, being diſguſted at the diſſolute lives of the women of his iſland, reſolved to live in perpetual celibacy; but making a ſtatue of ivory, he fell ſo paſſionately in love with it, that the high feſtival of Venus being come, he fell down before the altar of that goddeſs, and beſought her to give him a wife like the ſtatue he loved. At his return home, he embraced, as uſual, his ivory form, when he perceived that it became ſenſible by degrees, and was at laſt a living maid, who found herſelf in her lover's arms the moment ſhe ſaw the light. Venus bleſſed their union; and, at the end of nine months, ſhe was delivered of a boy, who was named *Paphos*.

PYGMY, a perſon not exceeding a cubit in height. This appellation was given by the ancients to a fabulous nation inhabiting Thrace; who brought forth young at five years of age, and were old at eight: theſe were famous for the bloody war they waged with the cranes. As to this ſtory, and for the natural hiſtory of the true pygmy, ſee Simia.

PYKAR, a broker in India, inferior to thoſe called *dallals*, who tranſacts the buſineſs at firſt hand with the manufacturer, and ſometimes carries goods about for ſale.

PYKE, a watchman in India, employed as a guard at night. Likewiſe a footman or runner on buſineſs. They are generally armed with a ſpear.

PYLADES, a ſon of Strophius, king of Phocis, by one of the ſiſters of Agamemnon. He was educated together with his couſin Oreſtes, with whom he formed the moſt inviolable friendſhip, and whom he aſſiſted to revenge the murder of Agamemnon, by aſſaſſinating Clytemneſtra and Ægyſthus. He alſo accompanied him in Taurica Cherſoneſus; and for his ſervices Oreſtes rewarded him, by giving him his ſiſter Electra in marriage. Pylades had by her two ſons, Medon and Strophius. The friendſhip of Oreſtes and Pylades became proverbial.

PYLORUS, in anatomy, the under orifice of the ſtomach. See Anatomy, n° 91.

PYLUS (anc. geog.), a town of Elis; its ruins to be ſeen on the road from Olympia to Elis, (Pauſanias); ſituated between the mouths of the Peneus and Sellees, near Mount Scollis, (Strabo.) Built by Pylas of Megara, and deſtroyed by Hercules, (Pauſanias.)—Another Pylus in Triphylia, (Strabo); by which the Alpheus runs, (Pauſanias); on the confines of Arcadia, and not in Arcadia itſelf, (id.)—A third in Meſſenia, (Strabo, Ptolemy); ſituated at the foot of Mount Ægaleus on the ſea-coaſt, over againſt the iſland Sphagea or Sphacteria: built by Pylas, and ſettled by a colony of Leleges from Megara; but thence expelled by Neleus and the Pelaſgi, and therefore called *Nelea*, (Homer.) A ſandy territory. The royal reſidence of Neleus, and of Neſtor his ſon: the more ancient and more excellent Pylus; whence the proverb *Pylus ante Pylum*, (Ariſtophanes, Plutarch), uſed when we want to repreſs the arrogance and pride of any one: ſaid to be afterwards called *Coryphaſium*. It made a figure in the Peloponneſian war; for being rebuilt by the Athenians, it proved of great benefit to them for the ſpace of 15 years, and of much annoyance to the Lacedemonians, (Thucydides). All the three *Pyli* were ſubject to Neſtor, (Strabo.)

PYRAMID, in geometry, a ſolid ſtanding on a triangular, ſquare, or polygonal baſis, and terminating in a point at the top; or, according to Euclid, it is a ſolid figure, conſiſting of ſeveral triangles, whoſe baſes are all in the ſame plane, and have one common vertex.

Pyramids are ſometimes uſed to preſerve the memory of ſingular events, and ſometimes to tranſmit to poſterity the glory and magnificence of princes. But as they are eſteemed a ſymbol of immortality they are moſt commonly uſed as funeral monuments and temples to the gods. Such is that of Ceſtius at Rome; the pyramids of Daſhur drawn by Pocock; and thoſe other celebrated ones of Egypt, as famous for the enormity of their ſize as their antiquity. Of theſe the largeſt are the pyramids of *Geeza*, ſo called from a village of that name on the banks of the Nile, diſtant from them about 11 miles. The three which moſt attract the attention of travellers ſtand near one another on the weſt ſide of the river, almoſt oppoſite to Grand Cairo, and not far from the place where the ancient Memphis ſtood. They were viſited by M. Savary, of whoſe deſcription of them we ſhall here give an abſtract.

He took his journey in the night-time, in order to get up to the top of the great one by ſunriſe. Having got within ſight of the two great ones, while the full moon ſhone upon them, he informs us, that they appeared, at the diſtance of three leagues, like two points of rock crowned by the clouds.

It is in the rich territory which ſurrounds them that fable has placed the Elyſian fields. The canals which interſect them are the Styx and Lethe.

"The aſpects of the pyramids varied according to the circuits he made in the plain, and the poſition of the clouds diſplayed themſelves more and more to view. At half paſt three in the morning we arrived (ſays he) at the foot of the greateſt. We left our cloathes at the gate of the paſſage which leads to the inſide, and deſcended, carrying each of us a flambeau in his hand. Towards the bottom you muſt creep like ſerpents to get into the interior paſſage, which correſponds with the former. We mounted it on our knees, ſupporting ourſelves with our hands againſt the ſides. Without this precaution one runs the riſk of ſlipping on the inclined plane, where the ſlight notches are inſufficient to ſtop the foot, and one might fall to the bottom. Towards the middle we fired a piſtol, the frightful noiſe of which, repeated in the cavities of this immenſe edifice, continued a long time, and awakened thouſands of bats, which flying round us, ſtruck againſt our hands and faces, and extinguiſhed ſeveral of our wax candles. They are much larger than the European bats. Arrived above, we entered a great hall, the gate of which is very low. It is an oblong ſquare, wholly compoſed of granite. Seven enormous ſtones extend from one wall to the other, and form the roof. A ſarcophagus made of a ſingle block of marble lies at one end of it. It is empty; and the lid of it has been wrenched off. Some pieces of earthen vaſes lie around it. Under this beautiful hall is a chamber not ſo large, where you find the entrance to a conduit filled with rubbiſh. After examining theſe caves, where daylight never penetrated, we deſcended the ſame way, taking care not to fall into a well, which is on the left, and goes to the very foundations of the pyramid. Pliny makes mention of this well, and ſays it is 26 cubits deep. The internal air of this edifice never being renewed, is ſo hot and mephitic that one is almoſt ſuffocated. When we came out of it, we were dropping with ſweat, and pale as death. After refreſhing ourſelves with the external air, we loſt no time in aſcending the pyramid. It is compoſed of more than 200 layers of ſtone. They overlap each other in proportion to their elevation, which is from two to four feet. It is neceſſary to climb up all theſe enormous ſteps to reach the top. We undertook it at the north-eaſt angle, which is the leaſt damaged. It took us, however, half an hour with great pains and many efforts to effect it.

“ The ſun was riſing, and we enjoyed a pure air, with a moſt delicious coolneſs. After admiring the proſpect around us, and engraving our names on the ſummit of the pyramid, we deſcended cautiouſly, for we had the abyſs before us. A piece of ſtone detaching itſelf under our feet or hands might have ſent us to the bottom.

“ Arrived at the foot of the pyramid, we made the tour of it, contemplating it with a ſort of horror. When viewed cloſe, it ſeems to be made of maſſes of rocks; but at a hundred paces diſtance, the largeneſs of the ſtones is loſt in the immenſity of the whole, and they appear very ſmall.

“ To determine its dimenſions is ſtill a problem. From the time of Herodotus to our days it has been meaſured by a great number of travellers and learned men, and their different calculations, far from clearing up doubts, have only increaſed the uncertainty. The following table will ſerve at laſt to prove how difficult it is to come at the truth.

	Height of the great Pyramid.	*Width of one of its ſides.*
Ancients.		French feet.
Herodotus	800	800
Strabo	625	600
Diodorus Siculus	600 and a fraction.	700
Pliny		708
Moderns.		
Le Bruyn	616	704
Proſper Alpinus	625	750
Thevenot	520	682
Niebuhr	440	710
Greaves	444	648

Number of layers of Stone which form it.

Greaves	207	layers.
Maillet	208	
Albert Liewenſtein	260	
Poccke	212	
Belon	250	
Thevenot	208	

“ It appears that Meſſrs Greaves and Niebuhr have prodigiouſly deceived themſelves in meaſuring the perpendicular height of the great pyramid. All the travellers allow that it has at leaſt 200 layers of ſtone. Theſe layers are from two to ſour feet high. According to Pococke, they are from four feet and a half to four feet high, being not ſo high at the top as at the baſe. Proſper Alpinus informs us, that the elevation of the firſt layer is five feet, but it diminiſhes inſenſibly in proportion as one mounts. Thevenot mentions 208 ſteps of large ſtones, the thickneſs of which makes the height of them about two feet and a half one with another: He meaſured ſome of them more than three feet high. I have meaſured ſeveral of them which were more than three feet high, and I found none leſs than two; the leaſt height of them we can take as a medium therefore is too feet and a half, which, even according to Mr Greaves's calculation, who reckons 207 layers, would make 517 feet 6 inches perpendicular height. Meſſrs Greaves, Maillet, Thevenot, and Pococke, who only differ in the number of the layers from 207 to 212, all mounted by the north-eaſt angle, as the leaſt injured. I followed the ſame route, and counted only 208 ſteps. But if we reflect that the pyramid has been open on the ſide next the deſert, that the ſtones on that ſide have been thrown down, that the ſand which covers them has formed a conſiderable hill, we ſhall not be aſtoniſhed that Albert Liewenſtein, Belon, and Proſper Alpinus, who muſt have mounted by the ſouth-eaſt or ſouth-weſt angle, which are leſs expoſed to the ſands of Lybia, ſhould have found a greater number of ſteps: ſo that the calculation of theſe travellers, agreeing with that of Diodorus Siculus and Strabo, appears to be neareſt the true height of the pyramid taken at its natural baſe; whence we may conclude with reaſon that it is at leaſt 600 feet high. Indeed this is authenticated by a paſſage of Strabo. Theſe are his words: ‘ Towards the middle of the height of one of the ſides is a ſtone that may be raiſed up. It ſhuts an oblique paſſage which leads to a coffin placed in the centre of the pyramid.’ This paſſage, open in our days, and which in the time of Strabo was towards the middle of one face of the pyramid, is at preſent only 100 feet from the baſe. So that the ruins of the covering of the pyramid, and of the ſtones brought from within, buried by the ſand, have formed a hill in this place 200 feet high. Pliny confirms this opinion. The great ſphynx was in his time upwards of 62 feet above the ſurface of the ground. Its whole body is at preſent buried under the ſand. Nothing more appears of it than the neck and head, which are 27 feet high. If even the ſphynx, though defended by the pyramids againſt the northerly winds, which bring torrents of ſand from Libya, be covered as high as 38 feet, what an immenſe quantity muſt have been heaped up to the northward of an edifice whoſe baſe is upwards of 700 feet long? It is to this we muſt attribute the prodigious difference between the accounts of the hiſtorians who have meaſured the great pyramid at diſtant periods, and at oppoſite angles. Herodotus, who ſaw it in the age neareſt to its foundation, when its true baſe was ſtill uncovered, makes it 800 feet ſquare. This opinion appears very probable. Pliny alſo ſays that it covered the ſpace of eight acres.

“ Meſſrs Shaw, Thevenot, and the other travellers who pretend that this pyramid was never finiſhed, becauſe it is open and without coating, are in an error. It is only neceſſary to obſerve the remains of the mortar, with the ſplinters of white marble which are to be found in many parts of the ſteps, to ſee that it has been coated. After reading attentively the deſcription given of it by the ancients, every doubt vaniſhes, and the truth is as clear as day-light. Herodotus tells us, ‘ The great pyramid was covered with poliſhed ſtones, perfectly well jointed, the ſmalleſt of which was 30 feet long. It was built in the form of ſteps, on each of which were placed wooden machines to raiſe the ſtones from one to another.’ According to Diodorus, ‘ The great pyramid is built of ſtones, very difficult of workmanſhip, but of an eternal duration. It is preſerved to our days (towards the middle of the Auguſtan age) without being in the leaſt injured. The marble was brought from the quarries of Arabia.’ This hiſtorian thought that the whole building was compoſed of ſtones, ſimilar to thoſe of the coating, which were of very hard marble. Had there been ſome pieces torn off, he would have perceived under that covering a calcareous ſtone rather ſoft. Pliny ſays that it ‘ is formed of ſtones brought from the quarries of Arabia. It is not far from the village of Buſiris (which ſtill exiſts under the name of *Bouſir*), where thoſe perſons reſide who are ſo ſkilful as to climb up to the top.’

“ This paſſage ſhows that Pliny, deceived by the appearance, was in the ſame error with Diodorous Siculus. It demonſtrates alſo that it was covered: for what difficulty would there have been for the inhabitants of Buſiris to ſcale a building raiſed by ſteps? but it was really a prodigy for them to get up it when it formed a mountain, the four inclined planes of which preſented a ſurface covered with poliſhed marble. It is indeed an inconteſtable fact, that the great pyramid was coated. It is as certain too that it has been ſhut, as Strabo gives us to underſtand, and that by removing a ſtone placed in the middle of one of the ſides, one found a paſſage which led to the tomb of the king. But I ſhall leave Mr Maillet, who viſited it 40 times with all imaginable attention, the honour of relating the means employed to open it. I have examined the inſide of it in two different journeys: twice I have mounted it: and I cannot help admiring the ſagacity with which that author has developed the mechaniſm of that aſtoniſhing edifice.”

Our author next proceeds to give a particular deſcription of the methods by which it is moſt probable that the pyramids were cloſed and the immenſe labour requiſite to open them; but as this deſcription affords nothing very intereſting, we ſhall not inſert it. Only we muſt remark, that the final outlet to the workmen he ſuppoſes to have been the well at the entrance formerly mentioned. This well deſcends towards the bottom of the pyramid by a line not quite perpendicular to the horizon, but ſlanting a little, in ſuch a manner as to reſemble the figure of the Hebrew letter Lamed. About 60 feet from the aperture there is a ſquare window in this paſſage, from whence we enter a ſmall grotto hewn out of the mountain; which in this place is not a ſolid ſtone, but a kind of gravel concreted together. The grotto extends about 15 feet from eaſt to weſt, where there is another groove hollowed likewiſe, but almoſt perpendicular. It is two feet four inches wide by two and an half in height. It deſcends through a ſpace of 123 feet, after which we meet with nothing but ſand and ſtones. M. Savary is convinced that the only uſe of this paſſage was to ſerve as a retreat for the labourers who conſtructed the pyramid; and of this he looks upon the ſlope of the conduit, its winding road, its ſmallneſs, and its depth, to be certain proofs. The way out of it he ſuppoſes to have been formed by a paſſage over which hung a row of ſtones, which they had diſcovered the ſecret of ſuſpending, and which falling down into the paſſage by the means of ſome ſpring they ſet in motion, ſhut up the entrance for ever, as ſoon as the workmen were withdrawn from the pyramid.

It ſeems to be an unqueſtionable fact, that this pyramid was a mauſoleum of one of the kings of Egypt, and it is very probable that all the reſt anſwered ſimilar purpoſes. We do not, however, think that this was their primary uſe or the original deſign of their builders. Mr Bryant is of opinion that they were temples erected in honour of the Deity; and a very ingenious writer in the Gentleman's Magazine for June 1794 has done much to prove that they were altars dedicated to the ſun, the firſt and greateſt god in every pagan kalender.

“ Our Engliſh word pyramid (ſays he) is directly derived from the Latin *pyramis*, and mediately from the Greek ϖυραμις; all denoting the ſame mathematical figure. The original of the whole ſeems to be the Egyptian word *pyramoua*, which, we are told by Oriental ſcholars, ſignifies light, or a ray of light. From this Coptic vocable the word ϖυρ in Greek, ſignifying fire, is probably deſcended; as the flames of fire aſſume that conical or pyramidal form which the ſolar rays commonly diſplay; and as it is natural for the mind to diſtinguiſh its objects rather by their external qualities, and thoſe obvious and intereſting appearances which they exhibit to the ſenſes, than by their conſtituent and inſeparable properties.

“The ancient Egyptians ſeem to have penetrated very far into the myſteries of nature; and although their ſuperſtition appears at firſt ſight to be extremely groſs and abſurd, yet it is very probable that their deities were only emblematical perſonages, repreſenting by ſenſible images the grand effects or preſiding principles which they ſuppoſed to exiſt in the univerſe. Thus the moon was called *Iſis*, and the ſun *Oſiris*; and to the honour of this laſt deity, from whoſe viſible influence and creative energy all things ſeem to ſpring into exiſtence, it is not improbable that the Egyptians erected thoſe ſtupendous monuments, and dedicated them to him as temples or altars. It was natural to build them in that ſhape which the rays of the ſun diſplay when diſcovered to the eye, and which they obſerved to be the ſame in terreſtrial flame, becauſe this circumſtance was combined in their imaginations with the attribute which they adored. If they were temples dedicated to the ſun, it ſeems a natural conſequence that they ſhould likewiſe be places of ſepulture for kings and illuſtrious men, as the ſpace which they covered would be conſidered as conſecrated ground. This hypotheſis is common, and is not contradicted by the preſent reaſoning. But, conſidering them as altars, and as moſt travellers agree that they were never finiſhed, but terminate in a ſquare horizontal ſurface, it would not be refining too much to venture an aſſertion that, in great and ſolemn acts of adoration, the Egyptians conſtructed fires, the flames of which ſhould terminate in the vertex of the pyramid, and ſo complete that emanation of their deity which they admired and adored. As far, therefore, as we are juſtified in forming any concluſion on ſo dark a ſubject, we

QUADRANT.

Plate CCCCXXVII

Fig. 6.

Gunners Quadrant

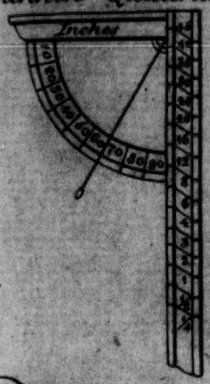


Fig. 1.

Coles Quadrant.

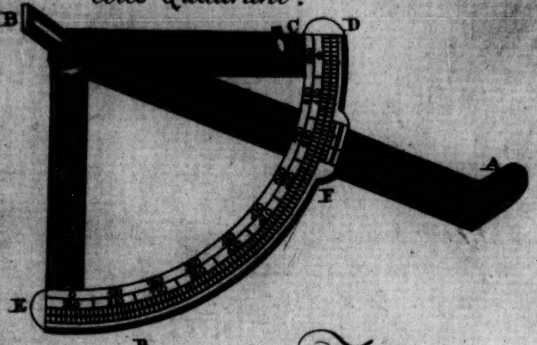


Fig. 4.

Suttons Quadrant.

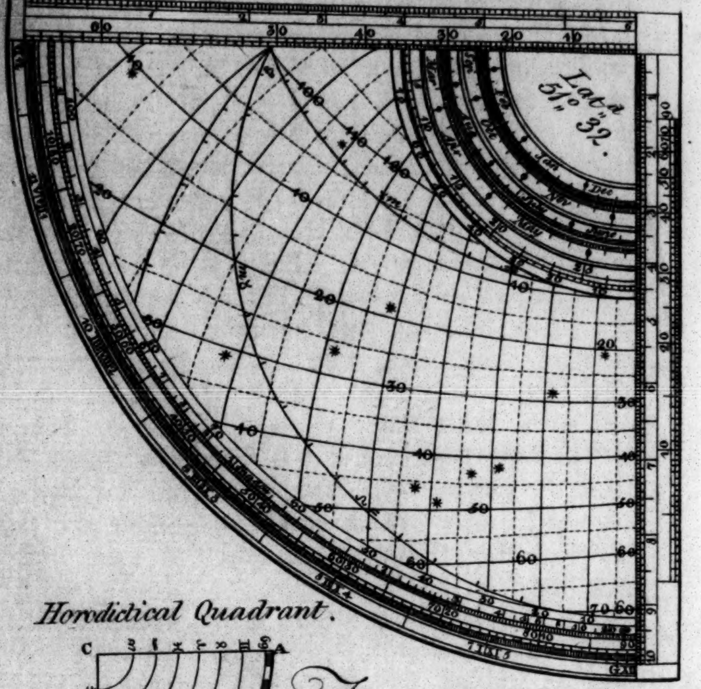


Fig. 5.

Sinical Quadrant.

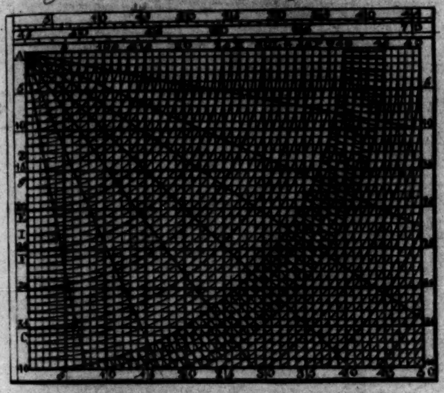
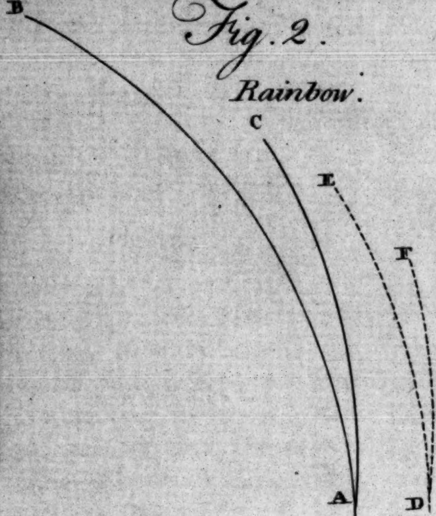


Fig. 2.

Rainbow.



Horodictical Quadrant.

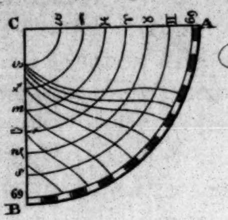
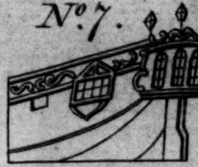


Fig. 3.

QUARTER.

N.° 7.



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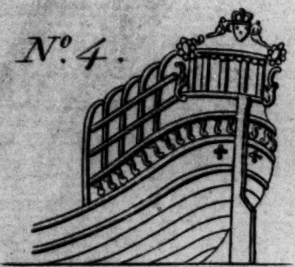

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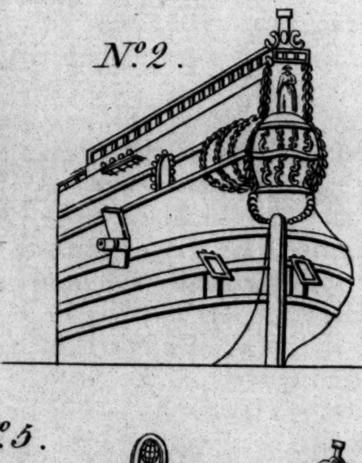

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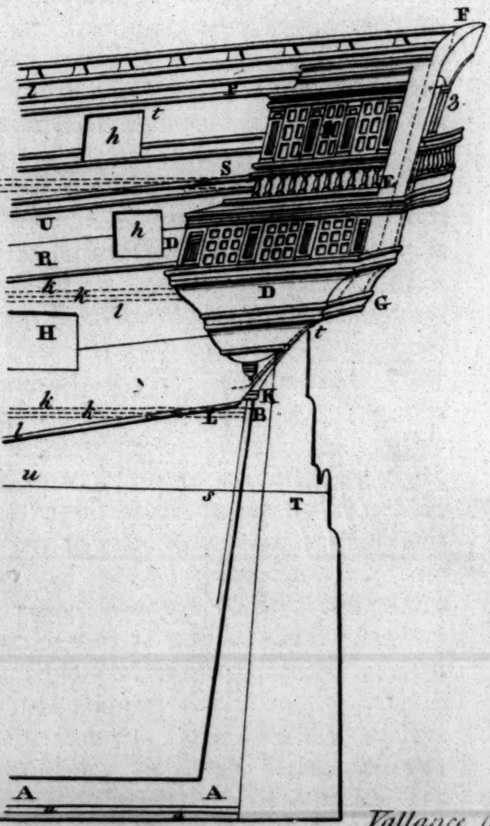
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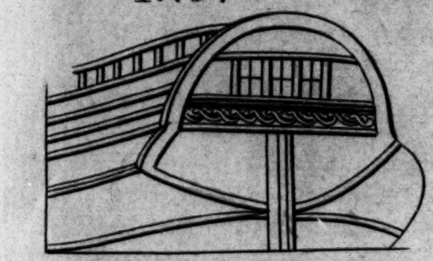

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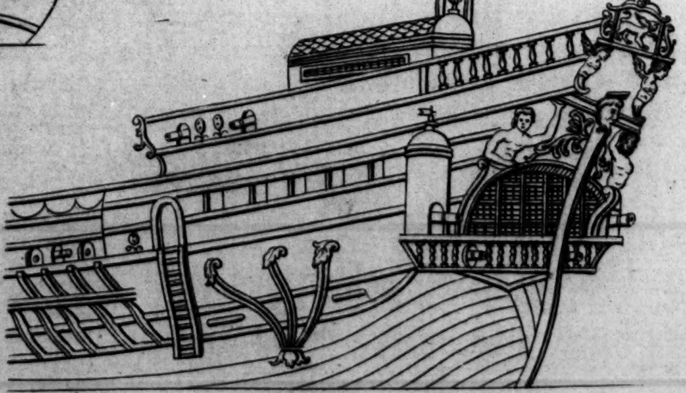

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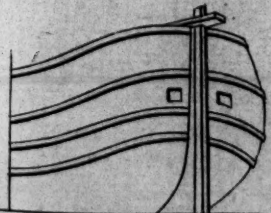

Vallance sc.

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we may venture to ſay, that the Egyptian pyramids were temples or altars dedicated to the ſun, as the material repreſentative of that inviſible power which creates, governs and pervades, the whole ſyſtem of nature."

This reaſoning has great force ; and it certainly receives additional ſtrength from the undoubted fact, that the firſt ſtatues for idolatrous worſhip were erected on the tops of mountains, and of a pyramidal or conical form. (See POLYTHEISM, n° 13 and 21.) It is likewiſe corroborated by other circumſtances diſcovered by the members of the Aſiatic Society. In the ſecond volume of their tranſactions we have an account of ſeveral large ſtatues of the gods SEEVA and MCHEDEO, all of a conical or pyramidal figure : but it has been ſhown in the article already referred to, that the idolatry of Hindoſtan was probably of Egyptian original.

It is not known in Europe when the pyramids were built; but we have reaſon to expect a hiſtory of them ſoon from Shanſcrit records examined by Mr Wilford lieutenant of engineers. It is as little known at what time, or from what motive, the great pyramid was opened. Some think it was done by one of the khalifs about the beginning of the eighth century, in expectation of finding a great treaſure; but all he met with was the king's body, with ſome golden idols which had been buried along with it.—By others it is ſuppoſed to have been done by the celebrated Harun Al Baſakid khalif of Bagdad; but all are agreed that this pyramid was opened in the time of the Arabs. The ſecond pyramid has likewiſe been opened; and an attempt was made not long ago upon the third by one of the Beys of Cairo : but after removing a number of ſtones at a conſiderable expence, he thought proper to deſiſt from the enterprize.—Mr Bryant is of opinion that the pyramids, at leaſt the three great ones, are not artificial ſtructures of ſtone and mortar, but ſolid rocks cut into a pyramidal ſhape, and afterwards caſed with ſtone ; and to this we find that Mr Bruce likewiſe aſſents. The reaſon given for this opinion is, that the paſſages within it ſeem rather to anſwer to the natural cavities and rents in rocks than to the artificial ones in buildings. The opinion, however, we think ſufficiently confuted by Savary and Maillet: and, as an acute critic obſerves, it is in itſelf as improbable as that the caverns inhabited by the *Troglodytes* were dug by the hands of man. See TROGLODYTES.

On the eaſt ſide of the ſecond pyramid is the ſphynx, an enormous maſs of one ſolid ſtone, but ſo buried in the ſand that only the top of the back is viſible, which is 100 feet long. Its head riſes, as we have ſeen, 27 feet above the ſand ; and its face has been disfigured by the Arabs, who hold all repreſentations of men and living animals in deteſtation. Other travellers ſay that this ſphynx is a huge miſhapen rock, by no means worthy of the attention which has been beſtowed upon it.

In the deſert of Saccara there are a great number of pyramids, which, in Mr Bruce's opinion, are compoſed of clay. They terminate in what the inhabitants call a *dagiour*, or *falſe pyramid*, about two miles from the Nile, between Suf and Woodan. This is no other than a hill cut into the ſhape of a pyramid, or naturally ſo formed, for a conſiderable height ; on the top of which is a pyramidal building of brick terminating in a point, and having its baſis ſo exactly adapted to the top of the hill, that at a diſtance the difference cannot be perceived ; eſpecially as the face of the ſtone reſembles very nearly the clay of which the pyramids of the Saccara are compoſed.

PYRAMIDALES, in anatomy, one of the muſcles of the abdomen. See ANATOMY, *Table of the Muſcles*.

PYRENEAN MOUNTAINS, or **PYRENEES**, are the mountains which divide France from Spain, and are the moſt celebrated in Europe, except the Alps. They reach from the Mediterranean Sea as far as the ocean, and are about 212 miles in length. They have different names, according to the different places wherein they ſtand. Some think they are as high as the Alps; but the paſſages over them are not ſo difficult, whatever ſome travellers may think who have not croſſed the former.

BANKSIA PYRIFORMIS, in botany, is a ſpecies of BANKSIA, which ſee. It was unknown to Linnæus; and Gaertner, who has mentioned it, gives no ſpecific character of it. It has ſolitary flowers, ovate downy capſules, and lance-ſhaped entire ſmooth leaves. The capſules larger than in any other known ſpecies. See *White's Journal of a Voyage to New South Wales*, p. 221—225.

PYRITES, a genus of inflammable ſubſtances compoſed of ſulphur, which has diſſolved or ſaturated itſelf with metals. Thus there are many kinds of pyrites ; as of gold, arſenic, iron, &c. It is alſo the principal ore of ſulphur ; particularly that called *martial pyrites*, *copperas-ſtone*, or *marcaſite*. This is very common, containing a quantity of ſulphur in proportion to the iron ; and, when thoroughly inflamed, burns by itſelf. It is either of a compact texture, ſteel-grained, coarſe-grained, or cryſtalliſed. In this laſt form it ſhoots moſtly into cube and octohedral figures, though it is met with alſo in innumerable other forms.

The liver-coloured marcaſite has an appearance between that of the preceding and the blue copper-ore. The iron predominates in this kind, ſo that it is leſs fit than the other for extracting ſulphur from it, or for the ſmelting of copper-ores. It is formed of a compact texture, coarſe-grained, and ſteel-grained. See CHEMISTRY, n° 619 and 654; MINERALOGY, p. 109 ; and METALLURGY, p. 429.

PYRMONT, a town of Lippe in Germany, in the circle of Weſtphalia, and capital of a country of the ſame name. It has a caſtle, kept by a governor, who is under the counts of Waldeck. At a ſmall diſtance from hence there are mineral waters, which are much eſteemed. The Proteſtants have here the free exerciſe of their religion. It is ſeated on the confines of the duchy of Brunſwick, 40 miles ſouth-weſt of Hanover. E. Long. 9. 0. N. Lat. 52. 0.

PYROLA, in botany : A genus of the monogynia order, belonging to the decandria claſs of plants ; and in the natural method ranking under the 18th order, *Bicornes*. The calyx is quinquepartite ; there are five petals ; the capſule is quinquelocular, opening at the angles.

PYROMANCY, a kind of divination by means of fire. See DIVINATION, n° 6.

PYROMETER, an inſtrument for meaſuring the expanſion of bodies by heat. See CHEMISTRY, n° 103. Muſchenbroeck, who was the original inventor of this machine, has given a table of the expanſion of the different metals in the ſame degree of heat. Having prepared cylindric rods of iron, ſteel, copper, braſs, tin, and lead, he expoſed them firſt to a pyrometer with one flame in the middle; then with two flames; and ſucceſſively to one with three, four, and five flames. But previous to this trial, he took care to cool them equally, by expoſing them ſome time upon the ſame ſtone, when it began to freeze, and Fahrenheit's thermometer was at 32 degrees. The effects of which experiment are digeſted in the following table, where the degrees of expanſion are marked in parts equal to the $\frac{1}{12500}$ part of an inch.

Expanſion of	Iron.	Steel.	Copper.	Braſs.	Tin.	Lead.
By one flame	80	85	89	110	153	155
By two flames placed cloſe together.	117	123	115	220		274
By two flames $2\frac{1}{2}$ inches diſtant.	109	94	92	141	219	263
By three flames placed cloſe together.	142	168	193	275		
By four flames placed cloſe together.	211	270	270	361		
By five flames.	230	310	310	377		

It is to be obſerved of tin, that it will eaſily melt when heated by two flames placed together. Lead commonly melts with three flames placed together, eſpecially if they burn long.

From theſe experiments, it appears at firſt view that iron is the leaſt rarefied of any of theſe metals, whether it be heated by one or more flames; and therefore is moſt proper for making machines or inſtruments which we would have free from any alterations by heat or cold, as the rods of pendulums for clocks, &c. So likewiſe the meaſures of yards or feet ſhould be made of iron, that their length may be as nearly as poſſible the ſame ſummer and winter.

The expanſion of lead and tin, by only one flame, is nearly the ſame; that is, almoſt double of the expanſion of iron. It is likewiſe obſervable, that the flames placed together, cauſe a greater rarefaction than when they have a ſenſible interval between them; iron in the former caſe, being expanded 117 degrees, and only 109 in the latter; the reaſon of which difference is obvious.

By comparing the expanſions of the ſame metal produced by one, two, three, or more flames, it appears that two flames do not cauſe double the expanſion of one, nor three flames three times that expanſion, but always leſs; and theſe expanſions differ ſo much the more from the ratio of the number of flames as there are more flames acting at the ſame time.

It is alſo obſervable, that metals are not expanded equally at the time of their melting, but ſome more ſome leſs. Thus tin began to run when rarefied 219 degrees; whereas braſs was expanded 377 degrees, and yet was far from melting.

Mr Ellicot found, upon a medium, that the expanſion of bars of different metals, as nearly of the ſame dimenſions as poſſible, by the ſame degree of heat, were as follow:

Gold,	Silver,	Braſs,	Copper,	Iron,	Steel,	Lead,
73	103	95	89	60	56	149

The great difference between the expanſions of iron and braſs has been applied with good ſucceſs to remedy the irregularities in pendulums ariſing from heat. See **Pendulum.**

Mr Graham uſed to meaſure the minute alterations, in length, of metal bars, by advancing the point of a micrometer-ſcrew, till it ſenſibly ſtopped againſt the end of the bar to be meaſured. This ſcrew, being ſmall and very lightly hung, was capable of agreement within the three or four-thouſandth part of an inch. On this general principle Mr Smeaton contrived his pyrometer, in which the meaſures are determined by the contact of a piece of metal with the point of a micrometer-ſcrew.

The following table ſhows how much a foot in length of each metal grows longer by an increaſe of heat, correſponding to 180° of Fahrenheit's thermometer, or to the difference between freezing and boiling water, expreſſed in ſuch parts of which the unit is equal to the 10,000th part of an inch.

1.	White-glaſs barometer tube, -	100
2.	Martial regulus of antimony, -	130
3.	Bliſtered ſteel, - -	138
4.	Hard ſteel, - -	147
5.	Iron, - -	151
6.	Biſmuth, - - -	167
7.	Copper hammered, - -	204
8.	Copper eight parts, with tin one, -	218
9.	Caſt braſs, - - -	225
10.	Braſs ſixteen parts, with tin one, -	229
11.	Braſs-wire, - - -	232
12.	Speculum metal, - -	232
13.	Spelter ſolder, viz. braſs two parts, zinc one,	247
14.	Fine pewter, - -	274
15.	Grain tin, - -	298
16.	Soft ſolder, viz. lead two, tin one,	301
17.	Zinc eight parts, with tin one, a little hammered, - - -	323
18.	Lead, - -	344
19.	Zinc or Spelter, -	353
20.	Zinc hammered half an inch per foot,	373

We ſhall cloſe this article with a brief deſcription of a pyrometer lately invented by M. De Luc, in conſequence of a hint ſuggeſted to him by Mr Ramſden. The baſis of this inſtrument is a rectangular piece of deal-board two feet and a half long, 15 inches broad, and one inch and a half thick; and to this all the other parts are fixed. This is mounted in the manner of a table, with four deal legs, each a foot long and an inch and a half ſquare, well fitted near its four angles, and kept together at the other ends by four firm croſs-pieces. This ſmall table is ſuſpended by a hook to a ſtand; the board being in a vertical ſituation in the direction of its grain, and bearing its legs forward in ſuch a manner as that the croſs-pieces which join them may form a frame, placed vertically facing the obſerver. This frame ſuſtains a microſcope, which is firmly fixed in another frame that moves in the former by means of grooves, but with a very conſiderable degree of tightneſs;

neſs; the friction of which may be increaſed by the preſſure of four ſcrews. The inner ſliding frame, which is likewiſe of deal, keeps the tube of the microſcope in a horizontal poſition, and in great part without the frame, inſomuch that the end which carries the lens is but little within the ſpace between the frame and the board. This microſcope is conſtructed in ſuch a manner as that the object obſerved may be an inch diſtant from the lens; and it has a wire which is ſituated in the focus of the glaſſes, in which the objects appear reverſed. At the top of the apparatus there is a piece of deal, an inch and a half thick and two inches broad, laid in a horizontal direction from the board to the top of the frame. To this piece the rods of the different ſubſtances, whoſe expanſion by heat is to be meaſured, are ſuſpended: one end of it ſlides into a ſocket, which is cut in the thickneſs of the board; and the other end, which reſts upon the frame, meets there with a ſcrew, which makes the piece move backward and forward, to bring the objects to the focus of the microſcope. There is a cork very ſtrongly driven through a hole bored vertically through this piece; and in another vertical hole made through the cork, the rods are fixed at the top; ſo that they hang only, and their dilatation is not counteracted by any preſſure. In order to heat the rods, a cylindrical bottle of thin glaſs, about 21 inches high, and four inches in diameter, is placed in the inſide of the machine, upon a ſtand independent of the reſt of the apparatus. In this bottle the rods are ſuſpended at a little leſs than an inch diſtance from one of the inſides, in order to have them near the microſcope. Into this bottle is poured water of different degrees of heat, which muſt be ſtirred about, by moving upwards and downwards, at one of the ſides of the bottle, a little piece of wood, faſtened horizontally at the end of a ſtick: in this water is hung a thermometer, the ball of which reaches to the middle of the height of the rods. During theſe operations the water riſes to the cork, which thus determines the length of the heated part; the bottle is covered, to prevent the water from cooling too rapidly at the ſurface; and a thin caſe of braſs prevents the vapour from fixing upon the piece of deal to which the rods are fixed.

PYROPHORUS, formed of πυρ, *fire*, and φερω, *I bear*, in chemiſtry, the name uſually given to that ſubſtance called by ſome black phoſphorus; a chemical preparation poſſeſſing the ſingular property of kindling ſpontaneouſly when expoſed to the air. See Chemistry, n° 1414.

This ſubſtance was accidentally diſcovered by M. Homberg, who prepared it of alum and human fæces. See Phosphorus. It was apprehended, for a conſiderable time after the diſcovery, that human fæces were eſſential to the operation, till the youngeſt ſon of the great Lemeri found that honey, ſugar, flour, and indeed any animal or vegetable matter, might be ſubſtituted inſtead of the human fæces; and ſince that time, M. De Sauvigny has ſhown that moſt vitriolic ſalts may be ſubſtituted for the alum; having added to the aluminous pyrophorus of Homberg two other claſſes of ſubſtances of this kind, viz. the metallic, or thoſe made with the three vitriols of iron, copper, and zinc; and the neutral, or thoſe compoſed of vitriolated tartar and Glauber's ſalt.

Mr Bewly prepares his pyrophorus in the following manner. "I fill (ſays he) half or three-fourths of the bowl of a tobacco-pipe with a mixture, conſiſting of two parts of alum, previouſly calcined in a red-heat, and of powdered charcoal and ſalt of tartar each one part; preſſing the matter down ſlightly, and filling the remainder of the bowl with fine ſand. As ſoon as the powder becomes hot, the ſand lying over it is put into a ſtate of ebullition, which generally continues ſeveral minutes. This appearance ſeems to proceed partly from the vitriolic acid in the alum leaving its earth, and expelling fixed air from the alkali; while another part of it is poſſibly converted into vitriolic acid air. This phenomenon is ſucceeded by the appearance of a blue ſulphureous flame, proceeding from the combination of the ſame acid with what was formerly called the *phlogiſton of the coal*, and which continues about ten minutes or a quarter of an hour. After it ceaſes, no other remarkable appearance preſents itſelf. The matter is now to be kept in a red heat 20 minutes or half an hour; or it may continue there two hours longer, if the operator pleaſes, without any injury to the pyrophorus. The pipe being taken out of the fire, the matter is knocked out of it as ſoon as it becomes cool, and generally pretty ſoon afterwards takes fire ſpontaneouſly."

In another experiment, having added ſucceſſively various and increaſing quantities of fixed alkali to the ſalt heated as above, till the vitriolic acid contained in the mixture might be conſidered merely as an evaneſcent quantity, a pyrophorus was ſtill produced on calcining it with charcoal as before. He alſo mixed equal parts of ſalt of tartar and vegetable or animal coal, or ſometimes three parts of the former with two of the latter, and calcined them in the uſual manner: and this compoſition, on being expoſed to the air, generally kindled in half a minute or a minute; though, as it contained no ſulphur, it did not burn with ſo much vivacity as the vitriolic pyrophori. This, which Mr Bewly calls the *alkaline pyrophorus*, differs in no circumſtance from M. De Sauvigny's neutral pyrophori, except in its not containing that principle to which he aſcribes their aſcenſion. However, leſt it might be ſuſpected that the ſalt of tartar which he employed might accidentally contain vitriolated tartar, or vitriolic acid, he repeated the experiment with tartar calcined by himſelf, as well as with nitre fixed or alkaliſed by deflagration with charcoal, and with iron filings; and in all theſe caſes with the ſame reſult. By diverſifying in a like manner M. De Sauvigny's experiments on the metallic pyrophori, Mr Bewly found that none of the three vitriols, heated with charcoal alone, in his uſual method, could produce a pyrophorus. And thus he found that the addition of an alkaline ſalt to the compoſition, which was a part of M. De Sauvigny's proceſs, was eſſential to its ſucceſs.

Treating in the uſual manner equal parts of calcined green vitriol and charcoal, the powder, which contained no ſulphur nor hepar ſulphuris, did not acquire any of the properties of a pyrophorus. The vitriolic acid ſeemed to have been entirely diſſipated, having no baſe to detain it, when diſlodged from the metallic earth. The charcoal and calx of iron left in this proceſs were calcined again, together with ſome ſalt of tartar: and a pyrophorus was produced, which exhibited indications of its containing a ſcarce perceptible portion of hepar ſulphuris. Thirty grains of crocus martis aſtringens were calcined with 15 grains of charcoal, and the ſame quantity of ſalt of tartar; and the mixture burnt ſpontaneouſly, though it contained no hepar ſulphuris or vitriolic acid. Having by theſe experiments evinced that metallic pyrophori may be prepared without vitriolic acid, Mr Bewly proceeded to form an aluminous pyrophorus of the ſame kind. For this purpoſe he procured the earth of alum by a long and violent calcination; and examining a part of it, he found, by the uſual teſts, that it neither contained any ſulphur, hepar ſulphuris, nor alum undecompounded. This he conſidered as perfectly pure, though he afterwards found that it contained a ſmall quantity of vitriolated tartar; and yet it repeatedly furniſhed a pyrophorus, as active as when alum itſelf is employed. From theſe and ſimilar experiments, he infers, that the ſeveral kinds of pyrophori are not kindled by moiſture, attracted by the vitroilic acid, as M. De Sauvigny has maintained: and his concluſion is farther confirmed by ſome experiments of Dr Prieſtley; from which it appears, that they are kindled in dry, nitrous, and what he calls deplogiſticated air.

M. Prouſt, cited by Mr Bewly, deſcribes a variety of new pyrophori, which neither contain vitriolic acid, nor ſeem likely to owe their accenſion to the attraction of humidity from the air. Theſe principally conſiſt of a coaly matter ſimply divided by metallic or other earths; ſuch are the ſediment left on the filter in preparing Goulard's extract, various combinations of tartar or its acid, or the acetous acid, with metals, calcareous earth, &c.

Mr Bewly, having evinced the inſufficiency of M. De Sauvigny's theory, and diſcovered that the pyrophori are not kindled by moiſture, attracted (merely) by the vitriolic acid, directed his attention to the nitrous acid, which Dr Prieſtly has ſhown to be a conſtituent part of atmoſpherical air, as the probable agent in the production of this phenomenon. The ſtrong affinity which this acid has with phlogiſton, and the heat, and even flame, which it is known to produce with certain inflammable matters, manifeſted that it was equal to the effect; and having excluded the vitriolic acid from having any eſſential concern in this operation, he ſuggeſts, either that the pyrophorus is kindled by moiſture attracted by ſome of the other ingredients which compoſe it; or that it has the power of decompounding atmoſpherical air, by ſuddenly attracting its nitrous acid, and thereby generating a heat ſufficient to kindle the phlogiſtic matter contained in it. This idea appeared plauſible, when he farther conſidered that Dr Prieſtley produced the pureſt reſpirable air with this ſame acid combined with other principles; and that this as well as common air is diminiſhed, and probably in part decompounded, in a variety of phlogiſtic proceſſes. This ingenious writer concludes, upon the whole, from the experiments he hath made, that the pyrophorus ſeems to owe its ſingular property to its being a combination of earth or alkali with phlogiſton: the vitriolic acid, when preſent, only occaſionally increaſing or diminiſhing the effect, according to circumſtances. In the proceſs of calcination, the earth or alkaline principle is not merely mixed, but actually, though looſely, combined with the phlogiſtic principle of the coal; ſo that the pyrophorus, conſidering it in its moſt ſimple ſtate, is only a perfectly dry phlogiſticated alkali or earth. On theſe data, the phenomena may be explained in the two following methods; with reſpect particularly to the influence of moiſture and heat upon the pyrophorus. Suppoſing either the alkaline or earthy principle to have a greater affinity to water than to the phlogiſton with which either of them is united, they may, on being expoſed to a moiſt atmoſphere, attract the humidity, and thereby ſet the phlogiſtic principle at liberty; which may, in its turn, attract, and be ignited by, the ſuppoſed aerial acid; its ſtrong affinity to which is well known:—or, if this hypotheſis be rejected, the inflammable matter may be kindled, merely in conſequence of the heat produced by the combination of the alkali, &c. with moiſture.

Mr Keir gives the following deſcription of a proceſs for preparing a new pyrophorus which he has lately diſcovered: "I filled about five-ſixths of the contents of a copper cylindrical box, which had a lid fitted to it, and which was three inches in diameter and two inches in depth, with ſaw-duſt, which I preſſed down; and I laid upon the ſaw-duſt as much well-waſhed *plumbum corneum* as entirely filled the box, which I then covered with its lid. I placed the box on the coals of a chamber-fire, ſo that its bottom only ſhould be in contact with the fuel, and I kept it on the fire till no more vapour ſeemed to iſſue at the joining of the lid. I then removed it from the fire; and while it was hot, I cloſed up the joining of the lid with ſealing-wax, by which means the external air was excluded. After it had ſtood in the cold about ten hours, I opened the box; and the corneous lead, which was very white before the operation, was now rendered black by the vapour which had ariſen from the ſaw-duſt, and which was obliged to paſs through the lead before it could eſcape. This black metallic maſs was no ſooner expoſed to the air, than ignited ſparks appeared, which ſpread more and more, while the lead was ſeen to revive in the form of minute globules, and the part which did not revive was changed into a yellow powder or calx of lead. It is to be obſerved, that before I opened the box, I placed it at the ſide of the fire, in order to melt the ſealing-wax, to enable me to ſeparate the lid. It is poſſible that this ſmall degree of heat may be neceſſary, or conducive, to the accenſion. I ought alſo to acquaint you, that the preparation of this pyrophorus requires nicer attention than that of any which I am acquainted with. For a ſmall exceſs of heat will revive the lead, which will ſpoil the experiment. Alſo, If any air be admitted through the joints of the veſſels employed, the kindling property will be prevented by the abſorption of the air; which in this caſe is generally too gradual to produce inflammation. The metallic ſubſtance in this ſtate of impregnation with inflammable matter, although not a pyrophorus, is an exceeding quick tinder. For when touched, however ſlightly, by an ignited body, it will inſtantly kindle, and the fire will ſpread over the whole piece, reviving the lead wherever it goes, and exhibiting a very beautiful example of metallic reduction, not unlike the familiar experiment of reviving the lead of a wafer containing minium at the flame of a candle; but with this difference, that the fire in the wafer requires to be kept up by flame; whereas in this metallic tinder it ſpreads and creeps ſpontaneouſly along without flame over the maſs.

der-making. Thoſe uſed for the deſert are the following, placed as they ſucceſſively ripen after one another: The white juncating, the margaret apple, the ſummer pearmain, the ſummer queening, the embroidered apple, the golden rennet, the ſummer white calville, the ſummer red calville, the ſilver pippen, the aromatic pippen, *la reinette griſe*, *la haute bonte*, the royal ruſſeting, Wheeler's ruſſet, Sharp's ruſſet, the ſpine apple, the golden pippen, the nonpareil, the *l'api* or *pomme d'api*. Thoſe for the kitchen uſe, in the order of their ripening, are theſe: The codling, the ſummer marygold, the ſummer red pearmain, the Holland pippen, the Kentiſh pippen, the courpendu, Loan's pearmain, the French rennet, the French pippen, the royal ruſſet, the monſtrous rennet, the winter pearmain, the *pomme violette*, Spencer's pippen, the ſtone pippen, and the oaken pippen. Thoſe moſt eſteemed for cyder are, the Devonſhire royal wilding, the redſtreak apple, the whitſour, the Herefordſhire under-leaf, and the John apple, or *deux annes*, everlaſting hanger, and gennet moyle.

The juice of apples is a menſtruum for iron. A ſolution of iron in the juice of the apples called *golden rennets*, evaporated to a thick conſiſtence, proves an elegant chalybeate, which keeps well.

The beſt method of preſerving apples for winter uſe, is to let them hang upon the trees until there is danger of froſt, to gather them in dry weather, and then to lay them in large heaps to ſweat for a month or ſix weeks. They ought then to be carefully looked over, all which have the leaſt appearance of decay taken out, the ſound fruit wiped dry, and packed up in large oil jars, which have been thoroughly ſcalded and dry, and then ſtopped cloſe to exclude the air. If this plan is duly obſerved, the fruit will keep a long time ſound, and their fleſh remain plump; whereas, when expoſed to the air, their ſkins will ſhrivel, and their pulp ſoften.

3. The coronaria, or ſweet-ſcented crab of Virginia, grows 12 or 15 feet high, having angular, ſerrated leaves, pedunculated umbels of whitiſh-red, ſweet-ſcented flowers, ſucceeded by ſmall round crabs, remarkably ſour and auſtere. There is one variety, called the *evergreen Virginian crab tree*.

Culture. All the varieties of the pear-tree are hardy, and will ſucceed in any common ſoil of a garden or orchard. They are propagated by grafting and budding upon any kind of pear-ſtocks; alſo occaſionally upon quince-ſtocks, and ſometimes upon white-thorn ſtocks; but pear-ſtocks are greatly preferable to all others for general uſe.—All kinds of apples are propagated in the ſame manner; uſing apple-ſtocks inſtead of pear-ſtocks. They will ſucceed in any common ſoil of a garden or orchard, and in any free ſituation except in a low and very moiſt ſoil, in which they are apt to canker, and very ſoon go off. In a friable loam they are generally very ſucceſsful.

PYTHAGORAS, a celebrated philoſopher of antiquity, reſpecting the time and place of whoſe birth the learned are much divided. Eratoſthenes aſſerts, that in the 48th Olympiad *, when he was very young, he was a victor at the Olympic games. Hence Dr Bentley † determines the date of his birth to be the 4th year of the 43d Olympiad; whilſt Lloyd ‡, who denies that the Olympic victor was the ſame perſon with the philoſopher, places it about the 3d year of the 48th Olympiad. Mr Dodwell § differs from both, and wiſhes to fix the birth of Pythagoras in the 4th year of the 52d Olympiad. Of the arguments of theſe learned writers, Le Clerc has given a ſummary in the *Bibliotheque Choiſée*, tom. x. p. 81. &c. and from a review of the whole, it would appear that he was not born earlier than the 4th year of the 43d Olympiad, nor later than the 4th year of the 52d; but in what particular year of that period his birth took place, cannot with any degree of certainty be aſcertained. It is generally believed that he was born in the iſland of Samos, and that he flouriſhed about 500 years before Chriſt, in the time of Tarquin the laſt king of Rome *. His father Mneſarchus, who is thought by ſome to have been a lapidary, and by others a merchant of Tyre, appears to have been a man of ſome diſtinction, and to have beſtowed upon his ſon the beſt education.

Jamblicus † relates a number of wonderful ſtories reſpecting Pythagoras's deſcent from Jupiter, his birth, and early life; and repreſents him even in his youth as a prodigy of wiſdom and manly ſeriouſneſs. But moſt of theſe idle tales confute themſelves, afford nothing of importance to be depended upon, and only prove the credulity, careleſſneſs, and prejudice of their author. Of his childhood and early education we know nothing, except that he was firſt inſtructed in his own country by Creophilus, and afterwards in Scyrus by Pherecydes (ſee PHERECYDES). According to the cuſtom of the times he was made acquainted with poetry and muſic; eloquence and aſtronomy became his private ſtudies, and in gymnaſtic exerciſes he often bore the palm for ſtrength and dexterity. He firſt diſtinguiſhed himſelf in greece at the Olympic games, where, beſide gaining the prize, he is ſaid to have excited the higheſt admiration by the elegance and dignity of his perſon, and the brilliancy of his underſtanding.

Soon after his appearance at theſe games Pythagoras commenced his travels in queſt of knowledge. He firſt viſited Egypt, where, through the intereſt of Polycrates tyrant of Samos, he obtained the patronage of Amaſis king of Egypt, by whoſe influence, combined with his own aſſiduity, patience, and perſeverance, he at length gained the confidence of the prieſts; from whom he learned their ſacred myſteries, theology, and the whole ſyſtem of ſymbolical learning. In Egypt, too, he became acquainted with geometry and the true ſolar ſyſtem; and, before he left that country, made himſelf maſter of all the learning for which it was ſo famed among the nations of antiquity.

He afterwards viſited Perſia and Chaldea, where from the Magi he learnt divination, the interpreting of dreams, and aſtronomy. He is likewiſe ſaid to have travelled into India, to have converſed with the Gymnoſophiſts, and to have acquired from them a knowledge of the philoſophy and literature of the eaſt; and ſuch was his ardour in the purſuit of ſcience, that in queſt of it, we are told by Cicero *, he croſſed many ſeas, and travelled on foot through many barbarous nations.

After Pythagoras had ſpent many years in gathering information on every ſubject, eſpecially reſpecting the nature of the gods, the rites of religion, and the immortality of the human ſoul, he returned to his native iſland, and attempted to make his knowledge uſeful by inſtituting a ſchool for the inſtruction of his countrymen. Failing of ſucceſs in this laudable undertaking, he repaired to Delos, where he pretended to receive moral dogmas from the prieſteſs of Apollo. He alſo viſited Crete, where he was initiated into the moſt ſacred myſteries of Greece. He went likewiſe to Sparta and Elis, and again aſſiſted at the Olympic games; where in the public aſſembly he was ſaluted with the title of *ſophiſt* or *wiſe man*, which he declined for one more humble. See PHILOLOGY, n° 1. and PHILOSOPHY n° 1.

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* An ante Chr. 588.

† Diſſert. on the Ep. of Phalaris.

‡ Chron. of Pythagoras.

§ Two Diſſertations on the age of Phalereus and Pythagoras.

* Tuſc. Queſt. lib. iv. cap. 1.

† Vit. Pythag. n. 6.

* De Finibus, lib. iv. § 29.

He returned to Samos enriched with mythological learning and myſterious rites, and again inſtituted a ſchool. His myſterious ſymbols and oracular precepts made this attempt more ſucceſsful than the former had been; but meeting with ſome oppoſition, or being detected in ſome pious frauds, he ſuddenly left Samos, retired to Magna Grecia, and ſettled at Crotona.

Here he founded the Italic ſect (ſee PHILOSOPHY n° 20.); and his mental and perſonal accompliſhments, the fame of his diſtant travels, and his Olympic crown, ſoon procured him numerous pupils. His bold and manly eloquence and graceful delivery attracted the moſt diſſolute, and produced a remarkable change in the morals of the people of Crotona. His influence was increaſed by the regularity of his own example, and its conformity to his precepts. He punctually attended the temples of the gods, and paid his devotions at an early hour; he lived upon the pureſt and moſt innocent food, clothed himſelf like the prieſts of Egypt, and by his continual purifications and regular offerings appeared to be ſuperior in ſanctity to the reſt of mankind. He endeavoured to aſſuage the paſſions of his ſcholars with verſes and numbers, and made a practice of compoſing his own mind every morning, by playing on his harp, and ſinging along with it the pæans of Thales. To avoid the temptations of eaſe and the ſeductions of idleneſs, bodily exerciſes alſo made a conſiderable part of his diſcipline.

At Crotona he had a public ſchool for the general benefit of the people, in which he taught them their duty, praiſing virtue and condemning vice; and particularly inſtructing them in the duties of ſocial life. Beſides this, he had a college in his own houſe, which he denominated κοινοβιον, in which there were two claſſes of ſtudents, viz. εξωτερικοι, who were alſo called *auſcultantes* and εσωτερικοι. The former of theſe were probationers, and were kept under a long examen. A ſilence of five years was impoſed upon them; which Apuleius thinks was intended to teach them modeſty and attention; but Clemens Alexandrinus thinks it was for the purpoſe of abſtracting their minds from ſenſible objects, and inuring them to the pure contemplation of the Deity. The latter claſs of ſcholars were called *genuini, perfecti, mathematici*, and, by way of eminence, *Pythagoreans*. They alone were admitted to the knowledge of the arcana and depths of Pythagoric diſcipline, and were taught the uſe of ciphers and hieroglyphic writings.

Clemens obſerves, that theſe orders correſponded very exactly to thoſe among the Hebrews: for in the ſchools of the prophets there were two claſſes, viz. the ſons of the prophets, who were the ſcholars, and the doctors or maſters, who were alſo called *perfecti*; and among the Levites, the novices or tyros, who had their quinquennial exerciſes, by way of preparation. Laſtly, even among the proſelytes there were two orders; *exoterici*, or proſelytes of the gate; and *intrinſeci* or *perfecti*, proſelytes of the covenant. He adds, it is highly probable, that Pythagoras himſelf had been a proſelyte of the gate, if not of the covenant. Gale endeavours to prove that Pythagoras borrowed his philoſophy from that of the Jews; to this end producing the authorities of many of the fathers and ancient authors, and even pointing out the tracks and footſteps of Moſes in ſeveral parts of Pythagoras's doctrine. But we believe the learned author was miſled by the Chriſtian Platoniſts.

The authority of Pythagoras among his pupils was ſo great, that it was even deemed a crime to diſpute his word; and their arguments were conſidered as infallibly convincing, if they could enforce them by adding, that "the maſter ſaid ſo;" an expreſſion which afterwards became proverbial in *jurare in verba magiſtri*. This influence over his ſchool was ſoon extended to the world, and even his pupils themſelves divided the applauſe and approbation of the people with their maſter; and the rulers and legiſlators of all the principal towns of Greece, Sicily, and Italy, boaſted of being the diſciples of Pythagoras. To give more weight to his exhortations, as ſome writers mention, Pythagoras retired into a ſubterraneous cave where his mother ſent him intelligence of every thing which happened during his abſence. After a certain number of months he again re-appeared on the earth with a grim and ghaſtly countenance, and declared in the aſſembly of the people that he was returned from hell. From ſimilar exaggerations it has been aſſerted that he appeared at the Olympic games with a golden thigh, and that he could write in letters of blood whatever he pleaſed on a looking-glaſs; and that by ſetting it oppoſite to the moon, when full, all the characters which were on the glaſs became legible on the moon's diſc. They alſo relate, that by ſome magical words he tamed a bear, ſtopped the flight of an eagle, and appeared on the ſame day and at the ſame inſtant in the cities of Crotona and Metapontum, &c.

At length his ſingular doctrines, and perhaps his ſtrenuouſly aſſerting the rights of the people againſt their tyrannical governors, excited a ſpirit of jealouſy, and raiſed a powerful party againſt him; which ſoon became ſo outrageous as to oblige him to fly for his life. His friends fled to Rhegium; and he himſelf, after being refuſed protection by the Locrians, fled to Metapontum, where he was obliged to take refuge in the temple of the muſes, and where it is ſaid he died of hunger about 497 years before Chriſt. Reſpecting the time, place, and manner of his death, however, there are various opinions, and many think it uncertain when, where, or in what manner, he ended his days. After his death his followers paid the ſame reſpect to him as was paid to the immortal gods; they erected ſtatues in honour of him, converted his houſe at Crotona into a temple of Ceres, appealed to him as a deity, and ſwore by his name.

Pythagoras married Theano of Crotona, or, according to others, of Crete, by whom he had two ſons, Telauges and Mneſarchus, who, after his death, took care of his ſchool. He is ſaid alſo to have had a daughter called *Damo*.

Whether he left any writings behind him is diſputed. It ſeems probable, however, that he left none, and that ſuch as went under his name were written by ſome of his followers. The *golden verſes* which Hierocles illuſtrated with a commentary, have been aſcribed to Epicharmus or Empedocles, and contain a brief ſummary of his popular doctrines. From this circumſtance, and from the myſterious ſecrecy with which he taught, our information concerning his doctrine and philoſophy is very uncertain, and cannot always be depended on.

The purpoſe of philoſophy, according to the ſyſtem of Pythagoras, is to free the mind from incumbrances, and to raiſe it to the contemplation of immutable truth and the knowledge of divine and ſpiritual objects. To bring the mind to this ſtate of perfection is a work of ſome difficulty, and requires a variety of intermediate ſteps. Mathematical ſcience was with him the firſt ſtep to wiſdom, becauſe it inures the mind to contemplation, and takes a middle courſe between corporeal and incorporeal beings. The whole ſcience he divided into two parts, *numbers* and *magnitude;* and each of theſe he ſubdivided into two others, the former into *arithmetic* and *muſic*, and the latter into *magnitude at reſt and in motion;* the former of which comprehends *geometry*, and the latter *aſtronomy*. Arithmetic he conſidered as the nobleſt ſcience, and an acquaintance with numbers as the higheſt good. He conſidered numbers as the principles of every thing; and divided them into ſcientific and intelligible. Scientific number is the production of the powers involved in unity, and its return to the ſame; number is not infinite, but is the ſource of that infinite diviſibility into equal parts which is the property of all bodies. Intelligible numbers are thoſe which exiſted in the divine mind before all things. They are the model or archetype of the world, and the cauſe of the eſſence of beings. Of the Monad, Duad, Triad, Tetrad, and Decad, various explanations have been given by various authors; but nothing certain or important is known of them. In all probability, numbers were uſed by Pythagoras as ſymbolical repreſentations of the firſt principles and forms of nature, and eſpecially of thoſe eternal and immutable eſſences which Plato denominated ideas; and in this caſe the monad was the ſimple root from which he conceived numbers to proceed, and as ſuch, analogous to the ſimple eſſence of deity; from whence, according to his ſyſtem, the various properties of nature proceed.

Muſic followed numbers, and was uſeful in raiſing the mind above the dominion of the paſſions. Pythagoras conſidered it as a ſcience to be reduced to mathematical principles and proportions, and is ſaid to have diſcovered the muſical chords from the circumſtance of ſeveral men ſucceſſively ſtriking with hammers a piece of heated iron upon an anvil. This ſtory Dr Burney[*] diſcredits; but allows, from the uniform teſtimony of writers ancient and modern, that he invented the *harmonical canon* or monochord, (ſee MONOCHORD.) The muſic of the ſpheres, of which every one has heard, was a moſt fanciful doctrine of Pythagoras. It was produced, he imagined, by the planets ſtriking on the ether through which in their motion they paſſed; and he conſidered their muſical proportions as exact, and their harmony perfect.

Pythagoras, as we have already ſeen, learned geometry in Egypt; but by inveſtigating many new theorems, and by digeſting its principles, he reduced it to a more regular ſcience. A geometrical point, which he defines to be a monad, or unity with poſition, he ſays correſponds to unity in arithmetic, a line to two, a ſuperficies to three, and a ſolid to four. He diſcovered ſeveral of the propoſitions of Euclid; and on diſcovering the 47th of book 1ſt, he is ſaid to have offered a hecatomb to the gods; but as he was averſe to animal ſacrifices, this aſſertion is ſurely falſe. His great progreſs in aſtronomical ſcience has been mentioned elſewhere. See ASTRONOMY, n° 11, 22; and PHILOSOPHY, n° 15, 16.

Wiſdom, according to Pythagoras, is converſant with thoſe objects which are naturally immutable, eternal, and incorruptible; and its end is to aſſimilate the human mind to the divine, and to qualify us to join the aſſembly of the gods. Active and moral philoſophy preſcribes rules and precepts for the conduct of life, and leads us to the practice of public and private virtue.—On theſe heads many of his precepts were excellent, and ſome of them were whimſical and uſeleſs. Theoretical philoſophy treats of nature and its origin, and is, according to Pythagoras, the higheſt object of ſtudy. It included all the profound myſteries which he taught, of which but little is now known. God he conſiders as the univerſal mind, diffuſed through all things, and the ſelf-moving principle of all things (αυτοματισμος τῶν παντῶν), and of whom every human ſoul is a portion[*]. It is very probable, that he conceived of the Deity as a ſubtle fire, eternal, active, and intelligent; which is not inconſiſtent with the idea of incorporeality, as the ancients underſtood that term. This Deity was primarily combined with the chaotic maſs of paſſive matter, but he had the power of ſeparating himſelf, and ſince the ſeparation he has remained diſtinct. The learned Cudworth contends, that Pythagoras maintained a trinity of hypoſtaſes in the divine nature, ſimilar to the Platonic triad (ſee PLATONISM). We cannot ſay that his arguments appear to have much force; but we think the concluſion which he wiſhes to eſtabliſh extremely probable, as Plato certainly drew his doctrine from ſome of the countries which Pythagoras had viſited before him.

Subordinate to the Deity there were in the Pythagorean creed three orders of intelligences, gods, demons, and heroes, of different degrees of excellence and dignity. Theſe, together with the human ſoul, were conſidered as emanations from the Deity, the particles of ſubtle ether aſſuming a groſſer clothing the farther they receded from the fountain. Hierocles defines a hero to be a rational mind united with a luminous body. God himſelf was repreſented under the notion of monad, and the ſubordinate intelligences as numbers derived from and included in unity. Man is conſidered as conſiſting of an elementary nature and a divine or rational ſoul. His ſoul, a ſelf-moving principle, is compoſed of two parts; the rational, ſeated in the brain; and the irrational, including the paſſions, in the heart. In both theſe reſpects he participates with the brutes, whom the temperament of their body, &c. allows not to act rationally. The ſenſitive ſoul periſhes; the other aſſumes an ethereal vehicle, and paſſes to the regions of the dead, till ſent back to the earth to inhabit ſome other body, brutal or human. See METEMPSYCHOSIS. It was unqueſtionably this notion which led Pythagoras and his followers to deny themſelves the uſe of fleſh, and to be ſo peculiarly merciful to animals of every deſcription. Some authors, however, ſay, that fleſh and beans, the uſe of which he alſo forbad, were prohibited, becauſe he ſuppoſed them to have been produced from the ſame putrified matter, from which, at the creation of the world, man was formed.

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[*] Hiſtory of Muſic, vol. i. p. 441.

[*] Cicero de Senect. § 21.

Of the ſymbols of Pythagoras little is known. They have been religiouſly concealed; and though they have awakened much curioſity, and occaſioned many ingenious conjectures, they ſtill appear to us dark and trifling. As a ſpecimen we give the following: "Adore the ſound of the whiſpering wind. Stir not the fire with a ſword. Turn aſide from an edged tool. Paſs not over a balance. Setting out on a journey, turn not back, for the furies will return with you. Breed nothing that hath crooked talons. Receive not a ſwallow into your houſe. Look not in a mirror by the light of a candle. At a ſacrifice pair not your nails. Eat not the heart or brain. Taſte not that which hath fallen from the table. Break not bread. Sleep not at noon. When it thunders touch the earth. Pluck not a crown. Roaſt not that which has been boiled. Sail not on the ground. Plant not a palm. Breed a cock, but do not ſacrifice it, for it is ſacred to the ſun and moon. Plant mallows in thy garden, but eat them not. Abſtain from beans."

The following precepts are more important: "Diſcourſe not of Pythagorean doctrines without light. Above all things govern your tongue. Engrave not the image of God in a ring. Quit not your ſtation without the command of your general. Remember that the paths of virtue and of vice reſemble the letter Y. To this ſymbol Perſius refers †, when he ſays,

Et tibi quæ Samios diduxit litera ramos,
Surgentem dextro monſtravit limite collem.

There has the Samian Y's inſtructive make
Pointed the road thy doubtful foot ſhould take;
There warn'd thy raw and yet unpractiſ'd youth,
To tread the riſing right-hand path of truth.

The ſcantineſs and uncertainty of our information reſpecting Pythagoras, renders a regular and complete account of his life and doctrines impoſſible. A modern author ‡ of profound erudition pronounces him to have been *unqueſtionably* the wiſeſt man that ever lived, if his maſters the Egyptian prieſts muſt not be excepted. This is ſaying a great deal too much; but that he was one of the moſt diſtinguiſhed philoſophers of antiquity, or, as Cicero expreſſes it, *vir præſtanti ſapientia*, appears very evident; and his moral character has never been impeached. The myſterious air which he threw over his doctrines, and the apparent inanity of ſome of his ſymbols, have indeed ſubjected him to the charge of impoſture, and perhaps the charge is not wholly groundleſs: but when we conſider the age in which he lived, and the nature of the people with whom he had to deal, who would in all probability have reſiſted more open innovations, even this will not appear ſo blameable as at firſt ſight we are apt to think it; and it is worthy of notice, that the worſt ſtories of this kind have come down to us in a very queſtionable ſhape, and with much probability appear to be falſe.

PYTHAGOREANS, a ſect of ancient philoſophers, ſo called from being the followers of Pythagoras. See the preceding article.

PYTHIA, the prieſteſs of Apollo at Delphi, by whom he delivered oracles. She was ſo called from Pythius, a name of that god, which is ſaid to have been given him on account of his victory over the ſerpent Python.

The Pythia was at firſt required to be a young girl, but in later times ſhe was a woman of 50 years of age. The firſt and moſt famous Pythia was Phenmonöe. Oracles were at firſt delivered by her in hexameter verſe. All the Pythias were to be pure virgins, and all of them delivered their oracles with great enthuſiaſm and violent agitations. See ORACLE and DELPHI.

PYTHIAN GAMES, in Grecian antiquity, ſports inſtituted near Delphos in honour of Apollo, on account of his ſlaying the ſerpent Python. See APOLLO.—Theſe games, at their firſt inſtitution, were celebrated only once in nine years; but afterwards every fifth year, from the number of the Parnaſſian nymphs who came to congratulate Apollo, and to make him preſents on his victory. The victor was crowned with garlands.

PYTHON, in fabulous hiſtory, a monſtrous ſerpent, produced by the earth after Deucalion's deluge. Juno being exaſperated at Latona, who was beloved by Jupiter, commanded this ſerpent to deſtroy her; but flying from the purſuit of the monſter, ſhe eſcaped to Delos, where ſhe was delivered of Diana and Apollo; the latter of whom at length deſtroyed Python with his arrows, in memory of which victory the Pythian games were inſtituted. See APOLLO.

Q.

Q, or *q*, the 16th letter and 12th conſonant of our alphabet; but is not to be found either in the Greek, old Latin, or Saxon alphabets; and indeed ſome would entirely exclude it, pretending that k ought to be uſed wherever this occurs. However, as it is formed in the voice in a different manner, it is undoubtedly a diſtinct letter: for, in expreſſing this ſound, the cheeks are contracted, and the lips, particularly the under, one, are put into a canular form, for the paſſage of the breath.

The q is never ſounded alone, but in conjunction with u, as in *quality*, *queſtion*, *quite*, *quote*, &c. and never ends any Engliſh word.

As a numeral, Q ſtands for 500; and with a daſh over it, thus $\bar{Q}$, for 500,000.

Uſed as an abbreviature, ſignifies *quantity*, or *quan-*

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† Sat. III. 56.

‡ Ancient Metaphyſics.

tum. Thus, among phyſicians, *q. pl.* is *quantum placet*, i. e. "as much as you pleaſe" of a thing; and *q. ſ.* is *quantum ſufficit*, i. e. "as much as is neceſſary." Q. E. D. among mathematicians, is *quod erat demonſtrandum*, i. e. "which was to be demonſtrated;" and Q. E. F. is *quod erat faciendum*, i. e. "which was to be done." Q. D. among grammarians, is *quaſi dictum*, i. e. "as it it were ſaid;" or, "as who ſhould ſay." In the notes of the ancients, Q ſtands for *Quintus*, or *Quintius*; Q. B. V. for *quod bene vertat*; Q. S. S. S. for *quæ ſupra ſcripta ſunt*; Q. M. for *Quintus Mutius*, or *quomodo*; Quint. for *Quintilius*; and Quæſ. for *quæſtor*.

QUAB, in ichthyology, the name of a Ruſſian fiſh, which is ſaid to be at firſt a tadpole, then a frog, and at laſt a fiſh. Dr Mounſey, who made many inquiries concerning theſe pretended changes, conſiders them all as fabulous. He had opportunity of ſeeing the fiſh itſelf, and found that they ſpawned like other fiſhes, and grew in ſize, without any appearances to juſtify the report. He adds, that they delight in very clear water, in rivers with ſandy or ſtony bottoms, and are never found in ſtanding lakes, or in rivers paſſing through marſhy or moſſy grounds, where frogs chooſe moſt to be.

QUABES, are a free people of Africa, inhabiting the ſouthern banks of the river Seſtos, and between that and Sierra Leona. They are under the protection of the emperor of Manow.

QUACHA, or QUAGGA. See EQUUS, n° 5.

Marg-grave's Hiſt. Braſil.

QUACHILTO, in ornithology, is the name of a very beautiful Braſilian bird, called alſo *yacazintli*, and *porphyrio Americanus*. It is of a fine blackiſh purple colour, variegated with white; its beak is white while young, but becomes red as it grows older, and has a naked ſpace at its baſis, reſembling in ſome ſort the coot; its legs are of a yellowiſh green; it lives about the waters, and feeds on fiſh, yet is a very well taſted bird. It imitates the crowing of a common cock, and makes its muſic early in the morning.

QUACK, among phyſicians, the ſame with empiric. See the article EMPIRIC.

QUADI, (Tacitus); a people of Germany, ſituated to the ſouth-eaſt of the mountains of Bohemia, on the banks of the Danube, and extending as far as the river Marus, or March, running by Moravia, which country they occupied.

QUADRAGESIMA, a denomination given to lent, from its conſiſting of 40 days. See LENT.

QUADRANGLE, in geometry, the ſame with a quadrilateral figure, or one conſiſting of four ſides and four angles.

QUADRANS, the quarter or fourth part of any thing, particularly the *as*, or pound.

QUADRANS, in Engliſh money, the fourth part of a penny. Before the reign of Edward I. the ſmalleſt coin was a *ſterling*, or penny, marked with a croſs; by the guidance of which a penny might be cut into halves for a halfpenny, or into quarters or four parts for farthings; till, to avoid the fraud of unequal cuttings, that king coined halfpence and farthings in diſtinct round pieces.

QUADRANT, in geometry, the arch of a circle, containing 90°, or the fourth part of the entire periphery.

Sometimes alſo the ſpace or area, included between this arch and two radii drawn from the centre to each extremity thereof, is called a *quadrant*, or, more properly, a *quadrantal ſpace*, as being a quarter of an entire circle.

QUADRANT, alſo denotes a mathematical inſtrument of great uſe in aſtronomy and navigation, for taking the altitudes of the ſun and ſtars, as alſo for taking angles in ſurveying, &c.

This inſtrument is variouſly contrived, and furniſhed with different apparatus, according to the various uſes it is intended for; but they all have this in common, that they conſiſt of a quarter of a circle, whoſe limb is divided into 90°. Some have a plummet ſuſpended from the centre, and are furniſhed with ſights to look through.

The principal and moſt uſeful quadrants are the common ſurveying quadrant, aſtronomical quadrant, Adams's quadrant, Cole's quadrant, Gunter's quadrant, Hadley's quadrant, horodictical quadrant, Sutton's or Collins's quadrant, and the ſinical quadrant, &c. Of each of which in order.

1. The common ſurveying quadrant, is made of braſs, wood, or any other ſolid ſubſtance; the limb of which is divided into 90°, and each of theſe farther divided into as many equal parts as the ſpace will allow, either diagonally or otherwiſe. On one of the ſemidiameters are fitted two moveable ſights; and to the centre is ſometimes alſo fixed a label, or moveable index, bearing two other ſights; but in lieu of theſe laſt ſights there is ſometimes fitted a teleſcope: alſo from the centre there is hung a thread with a plummet; and on the under ſide or face of the inſtrument is fitted a ball and ſocket, by means of which it may be put into any poſition. The general uſe of it is for taking angles in a vertical plane, comprehended under right lines going from the centre of the inſtrument, one of which is horizontal, and the other is directed to ſome viſible point. But beſides the parts already deſcribed, there is frequently added on the face, near the centre, a kind of compartment, called the *quadrat*, or *geometrical ſquare*. See QUADRAT.

This quadrant may be uſed in different ſituations: for obſerving heights or depths, its plane muſt be diſpoſed perpendicularly to the horizon; but to take horizontal diſtances, its plane is diſpoſed parallel thereto. Again, heights and diſtances may be taken two ways, viz. by means of the fixed ſights and plummet, or by the label: As to which, and the manner of meaſuring angles, ſee GEOMETRY, p. 674, &c.

2. The aſtronomical quadrant is a large one, uſually made of braſs, or wooden bars faced with iron plates; having its limbs nicely divided, either diagonally or otherwiſe, into degrees, minutes and ſeconds; and furniſhed with two teleſcopes, one fixed on the ſide of the quadrant, and the other moveable about the centre, by means of the ſcrew. There are alſo dented wheels which ſerve to direct the inſtrument to any object or phenomenon.—The uſe of this curious inſtrument, in taking obſervations of the ſun, planets, and fixed ſtars, is obvious; for being turned horizontally upon its axis, by means of the teleſcope, till the object is ſeen through the moveable teleſcope, then the degrees, &c. cut by the index give the altitude required. See ASTRONOMY, p. 587, &c.

Plate CCCCXXVII.

3. Cole's quadrant is a very uſeful inſtrument invented by Mr Benjamin Cole. It conſiſts of 6 parts, *viz.* the ſtaff AB (fig. 1.); the quadrantal arch DE; three vanes A, B, C; and the vernier FG. The ſtaff is a bar of wood about two feet long, an inch and a quarter broad, and of a ſufficient thickneſs to prevent it from bending or warping. The quadrantal arch is alſo of wood; and is divided into degrees, and third-parts of a degree, to a radius of about nine inches; to its extremities are fitted two radii, which meet in the centre of the quadrant by a pin, round which it eaſily moves. The ſight-vane A is a thin piece of braſs, almoſt two inches in height and one broad, placed perpendicularly on the end of the ſtaff A, by the help of two ſcrews paſſing through its foot. Through the middle of this vane is drilled a ſmall hole, through which the coincidence or meeting of the horizon and ſolar ſpot is to be viewed. The horizon vane B is about an inch broad, and two inches and a half high, having a ſlit cut thro' it of near an inch long and a quarter of an inch broad; this vane is fixed in the centre-pin of the inſtrument, in a perpendicular poſition, by the help of two ſcrews paſſing through its foot, whereby its poſition with reſpect to the ſight-vane is always the ſame, their angles of inclination being equal to 45 degrees. The ſhade-vane C is compoſed of two braſs plates. The one, which ſerves as an arm, is about four inches and a half long, and three quarters of an inch broad, being pinned at one end to the upper limb of the quadrant by a ſcrew, about which it has a ſmall motion; the other end lies in the arch, and the lower edge of the arm is directed to the middle of the centre-pin; the other plate, which is properly the vane, is about two inches long, being fixed perpendicularly to the other plate, at about half an inch diſtance from that end next the arch; this vane may be uſed either by its ſhade or by the ſolar ſpot caſt by a convex lens placed therein. And, becauſe the wood-work is often apt to warp or twiſt, therefore this vane may be rectified by the help of the ſcrew, ſo that the warping of the inſtrument may occaſion no error in the obſervation, which is performed in the following manner: Set the line G on the vernier againſt a degree on the upper limb of the quadrant, and turn the ſcrew on the backſide of the limb forward or backward, till the hole in the ſight-vane, the centre of the glaſs, and the ſunk ſpot in the horizon-vane, lie in a right line.

To find the ſun's altitude by this inſtrument: Turn your back to the ſun, holding the inſtrument by the ſtaff with your right hand, ſo that it be in a vertical plane paſſing through the ſun; apply your eye to the ſight-vane, looking through that and the horizon-vane till you ſee the horizon; with the left hand ſlide the quadrantal arch upwards, until the ſolar ſpot or ſhade, caſt by the ſhade-vane, fall directly on the ſpot or ſlit in the horizon-vane; then will that part of the quadrantal arch, which is raiſed above G or S (according as the obſervation reſpected either the ſolar ſpot or ſhade) ſhow the altitude of the ſun at that time. But if the meridian altitude be required, the obſervation muſt be continued; and as the ſun approaches the meridian, the ſea will appear through the horizon-vane, and then is the obſervation finiſhed; and the degrees and minutes, counted as before, will give the ſun's meridian altitude: or the degrees counted from the lower limb upwards will give the zenith-diſtance.

4. Adams's quadrant differs only from Cole's quadrant in having an horizontal vane, with the upper part of the limb lengthened; ſo that the glaſs, which caſts the ſolar ſpot on the horizon-vane, is at the ſame diſtance from the horizon-vane as the ſight-vane at the end of the index.

5. Gunter's quadrant, ſo called from its inventor Edmund Gunter, beſides the uſual apparatus of other quadrants, has a ſtereographical projection of the ſphere on the plane of the equinoctial. It has alſo a kalendar of the months, next to the diviſions of the limb.

Uſe of Gunter's quadrant. 1. To find the ſun's meridian altitude for any given day, or the day of the month for any given meridian altitude. Lay the thread to the day of the month in the ſcale next the limb; and the degree it cuts in the limb is the ſun's meridian altitude. Thus the thread, being laid on the 15th of May, cuts 59° 30′, the altitude ſought; and, contrarily, the thread, being ſet to the meridian altitude, ſhows the day of the month. 2. To find the hour of the day. Having put the bead, which ſlides on the thread, to the ſun's place in the ecliptic, obſerve the ſun's altitude by the quadrant; then, if the thread be laid over the ſame in the limb, the bead will fall upon the hour required. Thus ſuppoſe on the 10th of April, the ſun being then in the beginning of Taurus, I obſerve the ſun's altitude by the quadrant to be 36°; I place the bead to the beginning of Taurus in the ecliptic, and lay the thread over 36° of the limb; and find the bead to fall on the hour-line marked 3 and 9; accordingly the hour is either 9 in the morning or 3 in the afternoon. Again, laying the bead on the hour given, having firſt rectified or put it to the ſun's place, the degree cut by the thread on the limb gives the altitude. Note, the bead may be rectified otherwiſe, by bringing the thread to the day of the month, and the bead to the hour-line of 12. 3. To find the ſun's declination from his place given, and contrariwiſe. Set the bead to the ſun's place in the ecliptic, move the thread to the line of declination, and the bead will cut the degree of declination required. Contrarily, the bead being adjuſted to a given declination, and the thread moved to the ecliptic, the bead will cut the ſun's place. 4. The ſun's place being given, to find his right aſcenſion, or contrarily. Lay the thread on the ſun's place in the ecliptic, and the degree it cuts on the limb is the right aſcenſion ſought. Contrarily, laying the thread on the right aſcenſion, it cuts the ſun's place in the ecliptic. 5. The ſun's altitude being given, to find his azimuth, and contrariwiſe. Rectify the bead for the time, as in the ſecond article, and obſerve the ſun's altitude: bring the thread to the complement of that altitude; thus the bead will give the azimuth ſought, among the azimuth lines. 6. To find the hour of the night from ſome of the five ſtars laid down on the quadrant. (1.) Put the bead to the ſtar you would obſerve, and find how many hours it is off the meridian, by article 2. (2.) Then, from the right aſcenſion of the ſtar, ſubtract the ſun's right aſcenſion converted into hours, and mark the difference; which difference, added to the obſerved hour of the ſtar from the meridian, ſhows how many hours the ſun is gone from the meridian, which is the hour of the night. Suppoſe on the 15th of May the ſun is in the 4th degree of Gemini, I ſet the bead to Arcturus; and, obſerving his altitude, find him to be in the weſt about 50° high, and the bead to fall on the hour-line of 2 in the afternoon; then will the hour be 11 hours 50 minutes paſt noon, or 10 minutes ſhort of midnight: for 62°, the ſun's right aſcenſion, converted into time, makes 4 hours 8 minutes; which, ſubtracted from 13 hours 58 minutes, the right aſcenſion of Arcturus, the remainder will be 9 hours 50 minutes; which added to 2 hours, the obſerved diſtance of Arcturus from the meridian, ſhows the hour of the night to be 11 hours 50 minutes.

The mural quadrant has already been deſcribed under the article ASTRONOMY, n° 497. It is a moſt important inſtrument, and has of late been much improved by Mr Ramſden, who has diſtinguiſhed himſelf by the accuracy of his diviſions, and by the manner in which he finiſhes the planes by working them in a vertical poſition. He places the plumb-line behind the inſtrument, that there may be no neceſſity for removing it when we take an obſervation near the zenith. His manner of ſuſpending the glaſs, and that of throwing light on the object-glaſs and on the diviſions at the ſame time, are new, and improvements that deſerve to be noticed.—Thoſe of eight feet, which he has made for the obſervatories of Padua and Vilna, have been examined by Dr Maſkelyne; and the greateſt error does not exceed two ſeconds and a half. That of the ſame ſize for the obſervatory of Milan is in a very advanced ſtate. The mural quadrant, of ſix feet, at Blenheim, is a moſt admirable inſtrument. It is fixed to four pillars, which turn on two pivots, ſo that it may be put to the north and to the ſouth in one minute. It was for this inſtrument Mr Ramſden invented a method of rectifying the arc of 90 degrees, on which an able aſtronomer had ſtarted ſome difficulties; but by means of an horizontal line and a plumb-line, forming a kind of croſs, without touching the circle, he ſhowed him that there was not an error of a ſingle ſecond in the 90 degrees; and that the difference was occaſioned by a mural quadrant of Bird, in which the arc of 90 degrees was too great by ſeveral ſeconds, and which had never been rectified by ſo nice a method as that of Mr Ramſden.

But the quadrant is not the inſtrument which ſtands higheſt in Mr Ramſden's opinion; it is the complete circle: and he has demonſtrated to M. de la Lande, that the former muſt be laid aſide, if we would arrive at the utmoſt exactneſs of which an obſervation is capable. His principle reaſons are: 1. The leaſt variation in the centre is perceived by the two diametrically oppoſite points. 2. The circle being worked on the turn, the ſurface is always of the greateſt accuracy, which it is impoſſible to obtain in the quadrant. 3. We may always have two meaſures of the ſame arc, which will ſerve for the verification of each other. 4. The firſt point of the diviſion may be verified every day with the utmoſt facility. 5. The dilatation of the metal is uniform, and cannot produce any error. 6. This inſtrument is a meridian glaſs at the ſame time. 7. It alſo becomes a moveable azimuth circle by adding an horizontal circle beneath its axis, and then gives the refractions independent of the menſuration of time.

6. Hadley's quadrant is an inſtrument of vaſt utility both in navigation and practical aſtronomy. It derives its name from Mr Hadley, who firſt publiſhed an account of it, though the firſt thought originated with the celebrated Dr Hooke, and was completed by Sir Iſaac Newton (ſee ASTRONOMY, n° 32. and alſo n° 17. and 22.) The utility of this quadrant ariſes from the accuracy and preciſion with which it enables us to determine the latitude and longitude; and to it is navigation much indebted for the very great and rapid advances it has made of late years. It is eaſy to manage, and of extenſive uſe, requiring no peculiar ſteadineſs of hand, nor any ſuch fixed baſis as is neceſſary to other aſtronomical inſtruments. It is uſed as an inſtrument for taking angles in maritime ſurveying, and with equal facility at the maſt head as upon the deck, by which its ſphere of obſervation is much extended; for ſuppoſing many iſlands to be viſible from the maſt head, and only one from deck, no uſeful obſervation can be made by any other inſtrument. But by this, angles may be taken at the maſt head from the one viſible object with great exactneſs; and further, taking angles from heights, as hills, or a ſhip maſt's head, is almoſt the only way of exactly deſcribing the figure and extent of ſhoals.

It has been objected to the uſe of this inſtrument for ſurveying, that it does not meaſure the horizontal angles, by which alone a plan can be laid down. This objection, however true in theory, may be reduced in practice by a little caution; and Mr Adams has given very good directions for doing ſo.

Notwithſtanding, however, the manifeſt ſuperiority of this inſtrument over thoſe that were in uſe at the time of its publication, it was many years before the ſailors could be perſuaded to adopt it, and lay aſide their imperfect and inaccurate inſtruments; ſo great is the difficulty to remove prejudice, and emancipate the mind from the ſlavery of opinion. No inſtrument has undergone, ſince the original invention, more changes than the quadrant of Hadley; of the various alterations, many had no better foundation than the caprice of the makers, who by theſe attempts have often rendered the inſtrument more complicated in conſtruction, and more difficult in uſe, than it was in its original ſtate.

It is an eſſential property of this inſtrument, derived from the laws of reflection, that half degrees on the arch anſwer to whole ones in the angles meaſured: hence an octant, or the eighth part of a circle, or 45 degrees on the arch, ſerves to meaſure 90 degrees; and ſextants will meaſure an angular diſtance of 120 degrees, tho' the arch of the inſtrument is no more than 60 degrees. It is from this property that foreigners term that inſtrument an *octant*, which we uſually call a *quadrant*, and which in effect it is. This property reduces indeed conſiderably the bulk of the inſtrument: but at the ſame time it calls for the utmoſt accuracy in the diviſions, as every error on the arch is doubled in the obſervation.

Another eſſential, and indeed an invaluable, property of this inſtrument, whereby it is rendered peculiarly advantageous in marine obſervations, is, that it is not to be diſturbed by the ſhip's motion; for provided the mariner can ſee diſtinctly the two objects in the field of his inſtrument, no motion nor vacillation of the ſhip will injure his obſervation.

Thirdly, the errors to which it is liable are eaſily diſcovered and readily rectified, while the application and uſe of it is facile and plain.

To find whether the two ſurfaces of any one of the reflecting glaſſes be parallel, apply your eye at one end of it, and obſerve the image of ſome object reflected very obliquely from it; if that image appears ſingle, and well-defined about the edges, it is a proof that the ſurfaces are parallel: on the contrary, if the edge of the reflected images appear miſted, as if it threw a ſhadow from it, or ſeparated like two edges, it is a proof that the two ſurfaces of the glaſs are inclined to each other: if the image in the ſpeculum, particularly if that image be the ſun, be viewed through a ſmall teleſcope, the examination will be more perfect.

To find whether the ſurface of a reflecting glaſs be plane. Chooſe two diſtant objects, nearly on a level with each other; hold the inſtrument in an horizontal poſition, view the left hand object directly through the tranſparent part of the horizon-glaſs, and move the index till the reflected image of the other is ſeen below it in the ſilvered part: make the two images unite juſt at the line of ſeparation, then turn the inſtrument round ſlowly on its own plane, ſo as to make the united images move along the line of ſeparation of the horizon-glaſs. If the images continue united without receding from each other, or varying their reſpective poſition, the reflecting ſurface is a good plane.

To find if the two ſurfaces of a red or darkening glaſs are parallel and perfectly plane. This muſt be done by means of the ſun when it is near the meridian, in the following manner: hold the ſextant vertically, and direct the ſight to ſome object in the horizon, or between you and the ſky, under the ſun; turn down the red glaſs and move the index till the reflected image of the ſun is in contact with the object ſeen directly: fix then the index, and turn the red glaſs round in its ſquare frame; view the ſun's image and object immediately, and if the ſun's image is neither raiſed nor depreſſed, but continues in contact with the object below, as before, then the ſurfaces of the darkening glaſs are true.

For a more particular deſcription of Hadley's quadrant, and the mode of uſing it, ſee NAVIGATION, Book II. Chap. I.

This inſtrument has undergone ſeveral improvements ſince its firſt invention, and among theſe improvers muſt be ranked Mr Ramſden. He found that the eſſential parts of the quadrant had not a ſufficient degree of ſolidity; the friction at the centre was too great, and in general the alidada might be moved ſeveral minutes without any change in the poſition of the mirror; the diviſions were commonly very inaccurate, and Mr Ramſden found that Abbé de la Caille did not exceed the truth in eſtimating at five minutes the error to which an obſerver was liable in taking the diſtance between the moon and a ſtar; an error capable of producing a miſtake of 50 leagues in the longitude. On this account Mr Ramſden changed the principle of conſtruction of the centre, and made the inſtrument in ſuch a manner as never to give an error of more than half a minute; and he has now brought them to ſuch a degree of perfection as to warrant it not more than ſix ſeconds in a quadrant of fifteen inches. Since the time of having improved them, Mr Ramſden has conſtructed an immenſe number; and in ſeveral which have been carried to the Eaſt Indies and America, the deficiency has been found no greater at their return than it had been determined by examinations before their being taken out. Mr Ramſden has made them from 15 inches to an inch and a half, in the latter of which the minutes are eaſily diſtinguiſhable; but he prefers for general uſe thoſe of 10 inches, as being more eaſily handled than the greater, and at the ſame time capable of equal accuracy. See SEXTANT.

A great improvement was alſo made in the conſtruction of this quadrant by Mr Peter Dollond, famous for his invention of achromatic teleſcopes. The glaſſes of the quadrants ſhould be perfect planes, and have their ſurfaces perfectly parallel to one another. By a practice of ſeveral years, Mr Dollond found out methods of grinding them of this form to great exactneſs; but the advantage which ſhould have ariſen from the goodneſs of the glaſſes was often defeated by the index-glaſs being bent by the frame which contains it. To prevent this, Mr Dolland contrived the frame ſo that the glaſs lies on three points, and the part that preſſes on the front of the glaſs has alſo three points oppoſite to the former. Theſe points are made to confine the glaſs by three ſcrews at the back, acting directly oppoſite to the points between which the glaſs is placed. The principal improvements, however, are in the methods of adjuſting the glaſſes, particularly for the back-obſervation. The method formerly practiſed for adjuſting that part of the inſtrument by means of the oppoſite horizons at ſea, was attended with ſo many difficulties that it was ſcarce ever uſed: for ſo little dependence could be placed on the obſervations taken this way, that the beſt Hadley's ſextants made for the purpoſe of obſerving the diſtances of the moon from the ſun or fixed ſtars have been always made without the horizon-glaſs, for the back obſervation; for want of which, many valuable obſervations of the ſun and moon have been loſt, when their diſtance exceeded 120 degrees. To make the adjuſtment of the back-obſervation eaſy and exact, he applied an index to the back horizon-glaſs, by which it may be moved in a parallel poſition to the index-glaſs, in order to give it the two adjuſtments in the ſame manner as the fore-horizon-glaſs is adjuſted. Then, by moving the index to which the back-horizon-glaſs is fixed exactly 90 degrees (which is known by the diviſions made for that purpoſe), the glaſs will thereby be ſet at right angles to the index-glaſs, and will be properly adjuſted for uſe; and the obſervations may be made with the ſame accuracy by this as by the fore-obſervation. To adjuſt the horizon-glaſſes in the perpendicular poſition to the plane of the inſtrument, he contrived to move each of them by a ſingle ſcrew, which goes through the frame of the quadrant, and is turned by means of a milled head at the back; which may be done by the obſerver while he is looking at the object. To theſe improvements alſo he added a method invented by Mr Maſkelyne, of placing darkening-glaſſes behind the horizon-glaſſes. Theſe, which ſerve for darkening the object ſeen by direct viſion, in adjuſting the inſtrument by the ſun or moon, he placed in ſuch a manner as to be turned behind the fore horizon-glaſs, or behind the back horizon-glaſs: there are three of theſe glaſſes of different degrees of darkneſs.

We have been the more particular in our deſcription and uſe of Hadley's quadrant, as it is undoubtedly the beſt hitherto invented.

Plate CCCCXXVII.

7. Horodictical quadrant, a pretty commodious inſtrument, ſo called from its uſe in telling the hour of the day.—Its conſtruction is this: From the centre of the quadrant, C, fig. 3. whoſe limb AB is divided into 90°, deſcribe ſeven concentric circles at intervals at pleaſure; and to theſe add the ſigns of the zodiac, in the order repreſented in the figure. Then applying a ruler to the centre C and the limb AB, mark upon the ſeveral parallels the degrees correſponding to the altitude of the ſun when therein, for the given hours; connect the points belonging to the ſame hour with a curve line, to which add the number of the hour. To the radius CA fit a couple of ſights, and to the centre of the quadrant C tie a thread with a plummet, and upon the thread a bead to ſlide. If now the thread be brought to the parallel wherein the ſun is, and the quadrant directed to the ſun, till a viſual ray paſs through the ſights, the bead will ſhow the hour; for the plummet, in this ſituation, cuts all the parallels in the degrees correſponding to the ſun's altitude. Since the bead is in the parallel which the ſun deſcribes, and through the degrees of altitude to which the ſun is elevated every hour there paſs hour-lines, the bead muſt ſhow the preſent hour. Some repreſent the hour-lines by arches of circles, or even by ſtraight lines, and that without any ſenſible error.

8. Sutton's or Collins's quadrant (fig. 4.) is a ſtereographic projection of one quarter of the ſphere between the tropics, upon the plane of the ecliptic, the eye being in its north-pole: it is fitted to the latitude of London. The lines running from the right hand to the left are parallels of altitude; and thoſe croſſing them are azimuths. The leſſer of the two circles, bounding the projection, is one fourth of the tropic of Capricorn; the greater is one fourth of that of Cancer. The two ecliptics are drawn from a point on the left edge of the quadrant, with the characters of the ſigns upon them; and the two horizons are drawn from the ſame point. The limb is divided both into degrees and time; and, by having the ſun's altitude, the hour of the day may be found here to a minute. The quadrantal arches next the centre contain the calendar of months; and under them, in another arch, is the ſun's declination. On the projection are placed ſeveral of the moſt noted fixed ſtars between the tropics; and the next below the projection is the quadrant and line of ſhadows.—To find the time of the ſun's riſing or ſetting, his amplitude, his azimuth, hour of the day, &c. by this quadrant: lay the thread over the day and the month, and bring the bead to the proper ecliptic, either of ſummer or winter, according to the ſeaſon, which is called *rectifying;* then, moving the thread, bring the bead to the horizon, in which caſe the thread will cut the limb in the time of the ſun's riſing or ſetting before or after ſix; and at the ſame time the bead will cut the horizon in the degrees of the ſun's amplitude.—Again, obſerving the ſun's altitude with the quadrant, and ſuppoſing it found 45° on the fifth of May, lay the thread over the fifth of May, bring the bead to the ſummer ecliptic, and carry it to the parallel of altitude 45°; in which caſe the thread will cut the limb at 55° 15′, and the hour will be ſeen among the hour-lines to be either 41′ paſt nine in the morning, or 19′ paſt two in the afternoon.—Laſtly, the bead among the azimuths ſhows the ſun's diſtance from the ſouth 50° 41′. But note, that if the ſun's altitude be leſs than what it is at ſix o'clock, the operation muſt be performed among thoſe parallels above the upper horizon; the bead being rectified to the winter ecliptic.

9. Sinical quadrant (fig. 5.) conſiſts of ſeveral concentric quadrantal arches, divided into eight equal parts by radii, with parallel right lines croſſing each other at right angles. Now any one of the arches, as BC, may repreſent a quadrant of any great circle of the ſphere, but is chiefly uſed for the horizon or meridian. If then BC be taken for a quadrant of the horizon, either of the ſides, as AB, may repreſent the meridian; and the other ſide, AC, will repreſent a parallel, or line of eaſt and weſt: and all the other lines, parallel to AB, will be alſo meridians; and all thoſe parallel to AC, eaſt and weſt lines, or parallels.—Again, the eight ſpaces into which the arches are divided by the radii, repreſent the eight points of the compaſs in a quarter of the horizon; each containing 11° 15′. The arch BC is likewiſe divided into 90°, and each degree ſubdivided into 12′, diagonal-wiſe. To the centre is fixed a thread, which, being laid over any degree of the quadrant, ſerves to divide the horizon.

If the ſinical quadrant be taken for a fourth part of the meridian, one ſide thereof, AB, may be taken for the common radius of the meridian and equator; and then the other, AC, will be half the axis of the world. The degree of the circumference, BC, will repreſent degrees of latitude; and the parallels to the ſide AB, aſſumed from every point of latitude to the axis AC, will be radii of the parallels of latitude, as likewiſe the ſine complement of thoſe latitudes.

Suppoſe, then, it be required to find the degrees of longitude contained in 83 of the leſſer leagues in the parallel of 48°; lay the thread over 48° of latitude on the circumference, and count thence the 83 leagues on AB, beginning at A; this will terminate in H, allowing every ſmall interval four leagues. Then tracing out the parallel HE, from the point H to the thread; the part AE of the thread ſhows that 125 greater or equinoctial leagues make 6° 15′; and therefore that the 83 leſſer leagues AH, which make the difference of longitude of the courſe, and are equal to the radius of the parallel HE, make 6° 15′ of the ſaid parallel.

If the ſhip ſails an oblique courſe, ſuch courſe, beſides the north and ſouth greater leagues, gives leſſer leagues eaſterly and weſterly, to be reduced to degrees of longitude of the equator. But theſe leagues being made neither on the parallel of departure, nor on that of arrival, but in all the intermediate ones, we muſt find a mean proportional parallel between them. To find this, we have on the inſtrument a ſcale of croſs latitudes. Suppoſe then it were required to find a mean parallel between the parallels of 40° and 60°; with your compaſſes take the middle between the 40th and 60th degree on this ſcale: the middle point will terminate againſt the 51ſt degree, which is the mean parallel required.

The principal uſe of the ſinical quadrant is to form triangles upon, ſimilar to thoſe made by a ſhip's way with the meridians and parallels; the ſides of which triangles are meaſured by the equal intervals between the concentric quadrants and the lines N and S, E and W: and every fifth line and arch is made deeper than the reſt. Now, ſuppoſe a ſhip to have ſailed 150 leagues north-eaſt, one fourth north, which is the third point, and makes an angle of 33° 44′ with the north part of the meridian: here are given the courſe and diſtance ſailed, by which a triangle may be formed on the inſtrument ſimilar to that made by the ſhip's courſe; and hence the unknown parts of the triangle may be found. Thus, ſuppoſing the centre A to repreſent the place of departure; count, by means of the concentric circles along the point the ſhip ſailed on, viz. AD, 150 leagues: then in the triangle AED, ſimilar to that of the ſhip's courſe, find AE=difference of latitude, and DE=difference of longitude, which muſt be reduced according to the parallel of latitude come to.

10. Gunner's quadrant (fig. 6.), ſometimes called *gunner's ſquare*, is that uſed for elevating and pointing cannon, mortars, &c. and conſiſts of two branches either of braſs or wood, between which is a quadrantal arch divided into 90 degrees, beginning from the ſhorter branch, and furniſhed with a thread and plummet, as repreſented in the figure.——The uſe of the gunner's quadrant is extremely eaſy; for if the longeſt branch be placed in the mouth of the piece, and it be elevated till the plummet cut the degree neceſſary to hit a propoſed object, the thing is done. Sometimes on one of the ſurfaces of the long branch are noted the diviſion of diameters and weights of iron bullets, as alſo the bores of pieces.

Quadrant of Altitude, is an appendage of the artificial globe, conſiſting of a lamina, or ſlip of braſs, the length of a quadrant of one of the great circles of the globe, and graduated. At the end, where the diviſion terminates, is a nut rivetted on, and furniſhed with a ſcrew, by means whereof the inſtrument is fitted on the meridian, and moveable round upon the rivet to all points of the horizon.——Its uſe is to ſerve as a ſcale in meaſuring of altitudes, amplitudes, azimuths, &c. See Astronomy, n° 379, &c.

QUADRANTAL, in antiquity, the name of a veſſel in uſe among the Romans for the meaſuring of liquids. It was at firſt called *amphora*; and afterwards *quadrantal*, from its form, which was ſquare every way like a die. Its capacity was 80 libræ, or pounds of water, which made 48 ſextaries, two urnæ, or eight congii.

QUADRAT, a mathematical inſtrument, called alſo a *Geometrical Square*, and *Line of Shadows*: it is frequently an additional member on the face of the common quadrant, as alſo on thoſe of Gunter's and Sutton's quadrants. See Geomrtry, p. 672. and Plate CCXVII. fig. 1—5.

Quadrat, in printing, a piece of metal uſed to fill up the void ſpaces between words, &c. There are quadrats of different ſizes; as m-quadrats, n-quadrats, &c. which are reſpectively of the dimenſions of theſe letters, only lower, that they may not receive the ink.

QUADRATIC equations, in algebra, thoſe wherein the unknown quantity is of two dimenſions, or raiſed to the ſecond power. See Algebra.

QUADRATRIX, in geometry, a mechanical line, by means whereof we can find right lines equal to the circumference of circles, or other curves, and their ſeveral parts.

QUADRATURE, in geometry, denotes the ſquaring, or reducing a figure to a ſquare. Thus, the finding of a ſquare, which ſhall contain juſt as much ſurface or area as a circle, an ellipſis, a triangle, &c. is the quadrature of a circle, ellipſis, &c. The quadrature, eſpecially among the ancient mathematicians, was a great poſtulatum. The quadrature of rectilineal figures is eaſily found, for it is merely the finding their areas or ſurfaces *i. e.* their ſquares; for the ſquares of equal areas are eaſily found by only extracting the roots of the areas thus found. See Geometry, Part II. chap. 3. The quadrature of curvilinear ſpaces is of more difficult inveſtigation; and in this reſpect extremely little was done by the ancients, except the finding the quadrature of the parabola by Archimedes. In 1657, Sir Paul Neil, Lord Brouncker, and Sir Chriſtopher Wren, geometrically demonſtrated the equality of ſome curvilinear ſpaces to rectilinear ſpaces; and ſoon after the like was proved both at home and abroad of other curves, and it was afterwards brought under an analytical calculus; the firſt ſpecimen of which was given to the public in 1688 by Mercator, in a demonſtration of Lord Brouncker's quadrature of the hyperbola, by Dr Wallis's reduction of a fraction into an infinite ſeries by diviſion. Sir Iſaac Newton, however, had before diſcovered a method of attaining the quantity of all quadruple curves analytically by his fluxions before 1668. It is diſputed between Sir Chriſtopher Wren and Mr Huygens which of them firſt diſcovered the quadrature of any determinate cycloidal ſpace. Mr Leibnitz afterwards found that of another ſpace; and in 1669 Bernoulli diſcovered the quadrature of an infinity of cycloidal ſpaces both ſegments and ſectors, &c. See Geometry, Part II. chap. 3. prop. 33.; and Fluxions, p. 314.

Quadrature, in aſtronomy, that aſpect of the moon when ſhe is 90° diſtant from the ſun; or when ſhe is in a middle point of her orbit, between the points of conjunction and oppoſition, namely, in the firſt and third quarters. See Astronomy, n° 320, &c.

QUADRATUS, in anatomy, a name given to ſeveral muſcles on account of their ſquare figure. See Anatomy, *Table of the Muſcles*.

QUADREL, in building, a kind of artificial ſtone, ſo called from its being perfectly ſquare. The quadrels are made of a chalky earth, &c. and dried in the ſhade for two years. Theſe were formerly in great requeſt among the Italian architects.

QUADRIGA, in antiquity, a car or chariot drawn by four horſes. On the reverſes of medals, we frequently ſee the emperor or Victory in a quadriga, holding the reins of the horſes; whence theſe coins are, among the curious, called *nummi quadrigati*, and *victoriati*.

Quadri-lateral, Quadrille.

QUADRILATERAL, in geometry, a figure whoſe perimeter conſiſts of four ſides and four angles; whence it is alſo called a *quadrangular figure*.

QUADRILLE, a little troop or company of cavaliers, pompouſly dreſſed, and mounted for the performance of carouſals, juſts, tournaments, runnings at the ring, and other gallant divertiſements.

QUADRILLE, a game played by four perſons, with 40 cards; which are the remains of a pack, after the four tens, nines, and eights are diſcarded; theſe are dealt three and three, and one round four, to the right hand player; and the trump is made by him that plays with or without calling, by naming ſpades, clubs, diamonds, or hearts, and the ſuit named is trumps. If the perſon who names the trump ſhould miſtake, and ſay ſpades inſtead of clubs, or if he name two ſuits, the firſt named is the trump.

In this game the order of the cards, according to their natural value, is as follows: of hearts and diamonds, *king, queen, knave, ace, deuce, three, four, five, ſix, ſeven;* in all 10; of ſpades and clubs, *king, queen, knave, ſeven, ſix, five, four, three, deuce;* in all 9. The reaſon why the ace of ſpades and ace of clubs are not mentioned, is, becauſe they are always trumps, in whatever ſuit that is played. The ace of ſpades being always the firſt, and the ace of clubs the third trump, for the cards ranked according to their value when *trumps* ſtand in the following order.

Hearts and diamonds SPADILL, or the *ace of ſpades;* MANILL, the *ſeventh* of the two *red ſuits;* BASTO, the *ace of clubs;* PONTO, the *ace of hearts* and *diamonds;* *king, queen, knave, deuce, three, four, five, ſix;* in all 12. Spades and clubs, SPADILL the ace of ſpades, MANILL the *deuce* of ſpades and clubs, BASTO the ace of clubs; *king, queen, knave, ſeven, ſix, five, four, three;* in all 11. It is here to be obſerved, that the card which is *manill* and the ſecond trump, is always the loweſt in its ſuit when not trumps; and that the ace of hearts or diamonds, which when trump is above the king, is below the knave when not trump.

There are three matadores; ſpadill, manill, and baſto; the privilege of which is, that when the player has no other trumps but them, and trumps are led, he is not obliged to play them, but may play what card he thinks proper, provided, however, that the trump led is of an inferior rank; but if ſpadill ſhould be led, he that has manill or baſto only, is obliged to play it; it is the ſame of manill, baſto, with reſpect to the ſuperior matadore always forcing the inferior. Though there are properly but three matadores, nevertheleſs, all thoſe trumps which follow the three firſt without interruption, are likewiſe called matadores; but the three firſt only enjoy the privilege abovementioned.

Each perſon is to play as he judges moſt convenient for his own game. He is not to encourage his friend to play; but each perſon ought to know what to do when it is his turn to play. The ſtakes conſiſt of ſeven equal mils or *contrats*, as they are ſometimes called, compriſing the ten counters and fiſhes, which are given to each player. A mil is equal to ten fiſh, and each fiſh to ten counters: the value of the fiſh is according to the players agreement, as alſo the number of tours, which are generally fixed at ten, and marked by turning the corners of a card.

Quadrille.

If the cards ſhould happen not to be dealt right, or that there ſhould be two cards of the ſame ſort, as two deuces of ſpades, for example, there muſt be a new deal; provided it is diſcovered before the cards are all played. The cards muſt likewiſe be dealt over again in caſe a card is turned in dealing, as it might be of prejudice to him who ſhould have it; and of courſe if there ſhould be ſeveral cards turned. There is no penalty for dealing wrong, he who does ſo muſt only deal again.

When each player has got his ten cards, he that is on the right hand of the dealer, after examining his game, and finding his hand fit to play, aſks if they play; or if he has not a good hand, he paſſes, and ſo the ſecond, third, and fourth. All the four may paſs; but he that has ſpadill, after having ſhown or named it, is obliged to play by calling a king. Whether the deal is played in this manner, or that one of the players has aſked leave, nobody chooſing to play without calling, the eldeſt hand muſt begin the play, firſt naming his ſuit, and the king which he calls; he who wins the trick plays another card, and ſo of the reſt till the game is finiſhed. The tricks then are counted; and if the ombre, that is, he who ſtands the game, has, together with him who is the king called, ſix tricks, they have won and are paid the game, the conſolation, and the matadores, if they have them, and divide what is upon the game, and the beaſts if there are any. But if they make only five tricks, it is a remiſe, and they are beaſted, what goes upon the game, paying to the other players the conſolation and the matadores. If the tricks are equally divided betwixt them, they are likewiſe beaſted; and if they make only four tricks between them, it is a remiſe; if they make leſs they loſe codill (A), and in that caſe they pay to their adverſaries what they ſhould have received if they had won; that is, the game, the conſolation, and the matadores, if they have them, and are beaſted what is upon the game: they who win codill, divide the ſtakes. The beaſt, and every thing elſe that is paid, is paid equally betwixt the two loſers; one half by him that calls, and the other half by him that is called, as well in caſe of codill as a remiſe; unleſs the ombre does not make three tricks, in which caſe he that is called is not only exempted from paying half the beaſt, but alſo the game, the conſolation, and the matadores if there are any, which the ombre in that caſe pays alone; and as well in caſe of a codill as a remiſe. This is done in order to oblige players not to play games that are unreaſonable. There is, nevertheleſs, one caſe in which if the ombre makes only one trick, he is not beaſted alone, and that is, when not having a good hand he paſſes, and all the other players have paſſed likewiſe; he having ſpadill is obliged to play. Here it would be unjuſt to oblige him to make three or four tricks; in this caſe, therefore, he that is

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(A) Codill is when thoſe who defend the pool make more tricks than they who ſtand the game; which is called *winning the codill*.

called pays one half of the loſings. For which reaſon he that has ſpadill with a bad hand, ſhould paſs, that if he is afterwards obliged to play by calling a king (which is called *forced ſpadill)*, he may not be beaſted alone. He that has once paſſed cannot be admitted to play; and he that has aſked leave cannot refuſe to play, unleſs any one ſhould offer to play without calling.

He that has four kings, may call a queen to one of his kings, except that which is trump. He that wants one or more kings, may call one of thoſe kings; but in that caſe, he muſt make ſix tricks alone, and conſequently he wins or loſes alone. The king of that ſuit in which he plays cannot be called. No one ſhould play out of his turn, although he is not beaſted for ſo doing. If he who is not the eldeſt hand has the king called, and plays ſpadill, manill, or baſto, or even the king called in order to ſhow that he is the friend, having other kings that he fears the ombre ſhould trump, he is not to be allowed to go for the vole; he is even beaſted, if it appears to be done with that intent. It is not permitted to ſhow a hand though codill may already be won; that it may be ſeen whether the ombre is beaſted alone. If the ombre or his friend ſhows their cards before they have made ſix tricks, thinking that they have made them, and there appears a poſſibility of preventing their making them, the other players can oblige them to play their cards as they think proper.

A player need only name his ſuit when he plays, without calling a king. He who plays without calling muſt make ſix tricks alone to win; for all the other players are united againſt him, and they are to do what they can to prevent his winning. He who plays without calling, is admitted to play in preference to him who would play with calling; however, if he that has aſked leave will play without calling, he has the preference of the other who would force him. Theſe are the two methods of play without calling that are called forced.

As he who plays without calling does not divide the winnings with any perſon, he conſequently, when he loſes, pays all by himſelf; if he loſes by remiſe he is beaſted, and pays each of the other players the conſolation, the *ſans appeller* (which is commonly, but improperly, called the *ſans prendre)*, and the matadores if there are any; if he loſes codill he is likewiſe beaſted, and pays to each player what he would have received from each if he had won. They who win codill divide what there is; and if there are any counters remaining, they belong to him of the three who ſhall have ſpadill or the higheſt trump the next deal. It is the ſame with regard to him who calls one of his own kings, he wins alone or loſes alone as in the other caſe, except the ſans appeller, which he does not pay if he loſes, or receive if he wins, although he plays alone.

If he plays ſans appeller, though he may have a ſure game, he is obliged to name his ſuit; which if he neglects to do, and ſhows his cards, and ſays, "I play ſans appeller;" in that caſe either of the other players can oblige him to play in what ſuit he pleaſes, although he ſhould not have one trump in that ſuit.

He who has aſked leave is not permitted to play ſans appeller, unleſs he is forced; in which caſe, as was ſaid before, he has the preference of the other that forces him.

A player is not obliged to trump when he has none of the ſuit led, nor play a higher card in that ſuit if he has it, being at his option although he is the laſt player, and the trick ſhould belong to the ombre; but he is obliged to play in the ſuit led if he can, otherwiſe he renounces. If he ſeparates a card from his game and ſhows it, he is obliged to play it, if by not doing it the game may be prejudiced, or if it can give any intelligence to his friend; but eſpecially if it ſhould be a matadore.—He that plays ſans appeller, or by calling himſelf, is not ſubject to this law. He may turn the tricks made by the other players, and count what has been played as often as it is his turn to play, but not otherwiſe. If inſtead of turning a player's tricks, he turns and ſees his game, or ſhows it to the other players, he is beaſted, together with him whoſe cards he turned; and each of them muſt pay one half of the beaſt.

If any one renounces, he is beaſted as often as he has renounced and it is detected; but a renounce is not made till the trick is turned. If the renounce is diſcovered before the deal is finiſhed, and has been detrimental to the game, the cards muſt be taken up again, and the game replayed from that trick where the renounce was made; but if the cards are all played, the beaſt is ſtill made, and the cards muſt not be replayed; except there ſhould be ſeveral renounces in the ſame deal: then they are to be played again, unleſs the cards ſhould be mixed. If ſeveral beaſts are made in the ſame deal, they all go together, unleſs it is otherwiſe agreed at the beginning of the party; and when there are ſeveral beaſts, the greateſt always goes firſt.

A great advantage accrues from being eldeſt hand at quadrille, which often renders it very diſagreeable to the reſt of the players, being obliged to paſs with a good hand unleſs they chooſe to play alone; and when it happens that the eldeſt hand having aſked leave, the ſecond player has three matadores, ſeveral trumps in back, and all ſmall cards, he cannot then even play alone; and having no chance of being called, he muſt paſs with this good hand. On account of which, this method has been thought expedient to remedy this defect of the game; each player having an opportunity of availing himſelf of the goodneſs of his game, by adding to the uſual method of playing the game that of the mediateur, and the favourite ſuit.

The firſt thing to be obſerved is that of drawing for places, which is done in this manner: One of the players takes four cards; a king, a queen, a knave, and an ace; each player draws one of theſe cards; and commonly he who comes in laſt, draws firſt. The perſon who draws the king ſits where he pleaſes, the queen at his right hand, the knave next the queen, and the ace on the left of the king. The king draws the favourite ſuit. The number of cards and perſons is the ſame at this game as the other, and is played in the ſame manner.

The favourite ſuit is determined by drawing a card out of the pack, and is of the ſame ſuit, during the whole party, of the card ſo drawn.

A king is the mediateur, which is demanded of the others by one of the players, who has a hand he expects to make five tricks of; and through the aſſiſtance of this king he can play alone and make ſix tricks.

In return for the king received, he gives what card he thinks proper with a fiſh; but muſt give two fiſh if it is in the favourite ſuit. He who aſks by calling in the ſavourite ſuit, has the preference to him who aſks by calling in any other; he who aſks with the mediateur, has the preference to him who aſks by calling in the favourite ſuit, and by playing alone is obliged to make ſix tricks to win. He who aſks with the mediateur in the favourite ſuit, has the preference to him who aſks with the mediateur in any other ſuit, and is obliged to play alone, and to make ſix tricks.

If ſans prendre is played in any other ſuit than the favourite, he who plays it has the preference to him who aſks only, or with the mediateur, or even he who plays in the favourite ſuit with the mediateur; and the ſans prendre in the favourite ſuit has the preference to all other players whatever.

The only difference between this method of playing the game and the other is, that when one of the players demands the mediateur he is obliged to play alone, and to make ſix tricks, as if he played ſans prendre. In this caſe he ſhould judge from the ſtrength of his hand, whether the aid of the king will enable him to play alone or not.

With the mediateur and without the favourite ſuit it is played in this manner. The game is marked and played the ſame as in common, except that a fiſh extraordinary is given to him who plays the mediateur, and to him who plays ſans prendre; that is, he who wins the mediateur receives 13 counters from each; and if he loſes by remiſe he pays 12 to each; and 13 if by codill. The winner of ſans prendre receives 17 counters from each; and if by remiſe he loſes, he pays 16 to each: and 17 if by codill.

The vole with the mediateur receives one fiſh only, as at common quadrille. The beaſts are alſo the ſame as the common game. The laſt game is generally played double, and is called *poulans*; but for thoſe who chooſe to play a higher game, they may play the double colour, which is called the *Turk*, and is double of the favourite ſuit. There is alſo a higher game than this called the *auóde*, which is paying whatever is agreed to him who happens to hold the two aces in his hand.

We have omitted many things reſpecting the mode of marking the game, and playing the vole, becauſe theſe are different in different caſes, and are to be learned only by practice. The game itſelf is a very inferior one; but he who wiſhes to know more of it, may conſult Hoyle's games improved by James Beaufort, Eſq; from which we have, with very little alteration, taken this article.

QUADRUPEDS, in zoology; thoſe animals which have four limbs or legs proceeding from the trunk of their body. See ZOOLOGY; in which article notice will be taken of the method of preſerving ſpecimens of theſe and other animals.

QUÆSTOR, ſee QUESTOR.

QUAGGA, or QUACHA See EQUUS, n° 5.

QUAIL, in zoology. See TETRAO.

Quails are to be taken by means of the call during their whole wooing time, which laſts from April to Auguſt. The proper times for uſing the call are at ſun-riſing, at nine o'clock in the morning, at three in the afternoon, and at ſun-ſet; for theſe are the natural times of the quail's calling. The notes of the cock and hen quail are very different; and the ſportſman who expects to ſucceed in the taking them muſt be expert in both: for when the cock calls, the anſwer is to be made in the hen's note; and when the hen calls, the anſwer is to be made in the cock's. By this means they will come up to the perſon, ſo that he may, with great eaſe, throw the net over them and take them. If a cock-quail be ſingle, on hearing the hen's note he will immediately come; but if he have a hen already with him, he will not forſake her. Sometimes, though only one quail anſwers to the call, there will three or four come up; and then it is beſt to have patience, and not run to take up the firſt, but ſtay till they are all entangled, as they will ſoon be.

The quail is a neat cleanly bird, and will not run much into dirty or wet places: in dewy mornings, they will often fly inſtead of running to the call; and in this caſe, it is beſt to let them go over the net, if it ſo happens that they fly higher than its top; and the ſportſman then changing ſides, and calling again, the bird will come back, and then will probably be taken in the net.

The calls are to be made of a ſmall leather purſe, about two fingers wide, and four fingers long, and made in the ſhape of a pear; this is to be ſtuffed half-full of horſe-hair, and at the end of it is to be placed a ſmall whiſtle, made of the bone of a rabbit's leg, or ſome other ſuch bone: this is to be about two inches long, and the end formed like a flageolet, with a little ſoft wax. This is to be the end faſtened into the purſe; the other is to be cloſed up with the ſame wax, only that a hole is to be opened with a pin, to make it give a diſtinct and clear ſound. To make this ſound, it is to be held full in the palm of the hand, with one of the fingers placed over the top of the wax; then the purſe is to be preſſed, and the finger is to ſhake over the middle of it, to modulate the ſound it gives into a ſort of ſhake. This is the moſt uſeful call; for it imitates the note of the hen-quail, and ſeldom fails to bring a cock to the net if there be one near the place.

The call that imitates the note of the cock, and is uſed to bring the hen to him, is to be about four inches long, and above an inch thick; it is to be made of a piece of wire turned round and curled, and covered with leather; and one end of it muſt be cloſed up with a piece of flat wood, about the middle of which there muſt be a ſmall thread or ſtrap of leather, and at the other end is to be placed the ſame ſort of pipe, made of bone, as is uſed in the other call. The noiſe is made by opening and cloſing the ſpiral, and gives the ſame ſound that the cock does when he gives the hen a ſignal that he is near her.

QUAKERS, a religious ſociety, which took its riſe in England about the middle of the laſt century, and rapidly found its way into other countries in Europe, and into the Engliſh ſettlements in North America.—The members of this ſociety, we believe, called themſelves at firſt *ſeekers*, from their *ſeeking* the truth; but after the ſociety was formed, they aſſumed the appellation of *friends*. The name of *quakers* was given to them by their enemies; and though an epithet of reproach, ſeems to be ſtamped upon them indelibly. Their founder

der is generally believed to have been George Fox, an illiterate ſhoemaker (ſee *George Fox*), but this opinion has been lately controverted. An ingenious writer ‡ having found, or fancied, a ſimilarity of ſentiments among the ancient Druids and modern Quakers, ſeems to think that Fox muſt have been nothing more than a tool employed by certain deiſts to pave the way for their ſyſtem of natural religion, by allegorizing the diſtinguiſhing articles of the Chriſtian faith.

It muſt be confeſſed, for experience will not allow it to be denied, that extremes in religion are very apt to beget each other; and if the deiſts alluded to reaſoned from this fact, they could not have pitched upon a tool fitter for their purpoſe than George Fox. From his works ſtill extant, he has been conſidered as one of the moſt extravagant and abſurd enthuſiaſts that ever lived, and to have fancied himſelf, in his apoſtolic character, ſomething infinitely ſuperior to man. In a book called *News coming out of the North* (p. 15.) he ſays of himſelf, "I am the Door that ever was, the ſame Chriſt yeſterday, to-day, and for ever:" And in the introduction to his *Battle-door for Teachers and Profeſſors*, he ſays, "All languages are to me no more than duſt, who was before languages were." But one of the moſt extraordinary and curious things that he ever wrote, is an anſwer to the Protector, who had required him to promiſe not to diſturb his government as then eſtabliſhed. It is as follows:

"I who am of the world called G: F doth deny the carrying or drawing any carnal ſword againſt any, or againſt thee O: C: or any man, in the preſence of the Lord I declare it, God is my witneſs, by whom I am moved to give this forth for the truth's ſake, from him whom the world calls G: Fox, *who is the ſon of God*, who is ſent to ſtand a witneſs againſt all violence and againſt the works of darkneſs, and to turn the people from darkneſs to light, and to bring them from the occaſion of the war and from the occaſion of the magiſtrates ſword, which is a terror to the evil doer, which acts contrary to the light of the Lord *Jeſus Chriſt*; which is a praiſe to them that do well; which is a protection to them that do well, and not the evil; and ſuch ſoldiers as are put in place no falſe accuſers muſt be, no violence muſt do, but be content with their wages: and that magiſtrate bears not the ſword in vain, from under the occaſion of that ſword do I ſeek to bring people: my weapons are not carnal but ſpiritual, and *my kingdom is not of this world*; therefore with carnal weapon I do not fight, but am from thoſe things dead, from him who is not of this world, called of the world by the name of G: F: and this I am ready to ſeal with my blood; this I am moved to give forth for the truth's ſake, who a witneſs ſtands againſt all unrighteouſneſs, and all ungodlineſs, who a ſufferer is for the righteous ſeed's ſake, waiting for the redemption of it, who a crown that is mortal ſeeks not, for that fadeth away; but in the light dwells which comprehends that crown, which light is the condemnation of all ſuch, in which light I witneſs the crown that is immortal, which fades not away from him who to all your ſouls is a friend, for eſtabliſhing of righteouſneſs, and clearing the land of evil doers, and a witneſs againſt all the wicked inventions of man, and murderer's plots, which anſwer ſhall be with the light in all your conſciences, which makes no covenant with death; to which light in you all I ſpeak, and am clear, G: F: who a new name hath, which the world knows not." (A).

The Quakers, however, did not long entruſt the defence of their principles to ſuch ſenſeleſs enthuſiaſts as George Fox: They were joined by a number of learned, ingenious, and pious men, who new modelled their creed; and though they did not bring it to what is generally deemed the Chriſtian ſtandard, they ſo reformed it as that its tenets do not ſhock common ſenſe, nor the duties preſcribed ſcandalize a man of piety. The chief of theſe reformers were George Keith, the celebrated Penn, and Robert Barclay. Keith was indeed excommunicated for the liberties which he took with the great apoſtle; but we have not a doubt but his writings contributed to the moderation of Penn, and to the elegant and maſterly apology of Barclay. From that apology we ſelected the ſummary of their opinions which was given in the former edition of this work; but they have lately publiſhed ſuch a ſummary themſelves, of which the reader will be pleaſed with the following abſtract:

They tell us, that about the beginning of the 17th century, a number of men, diſſatiſfied with all the modes of religious worſhip then known in the world, withdrew from the communion of every viſible church to ſeek the Lord in retirement. Among theſe was their *honourable elder George Fox*, who being quickened by the immediate touches of divine love, could not ſatiſfy his apprehenſions of duty to God without directing the people where to find the like conſolation and inſtruction. In the courſe of his travels, he met with many ſeeking perſons in circumſtances ſimilar to his own, and theſe readily received his teſtimony. They then give us a ſhort account of their ſufferings and different ſettlements; and with a degree of candour which does them great credit, they vindicate Charles II. from the character of a perſecutor; acknowledging, that though they ſuffered much during his reign, he gave as little countenance as he could to the ſeverities of the legiſlature. They even tell us, that he exerted his influence to reſcue their friends from the unprovoked and cruel perſecutions of the New England fanatics; and they ſpeak with becoming gratitude of the different acts paſſed in their favour during the reigns of William and Mary, and George I. They then proceed to give us the following account of their doctrine:

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‡ See Month. Rev. Sept. 1793, art. 5.

(A) We have tranſcribed this letter from the theological works of Mr Leſlie, where it is preſerved in its original form. The Quakers, after the death of their apoſtle, expunged from their edition of it the words which we have printed in Italics; aſhamed, as we hope, of the blaſphemy imputed to them: but that Mr Leſlie's copy is authentic, is thus atteſted by two of the friends, who ſaw Fox deliver it to the protector's meſſenger: "We are witneſſes of this teſtimony, whoſe names in the fleſh are,

Tho. Aldam.
Rob. Craven.

"We agree with other profeſſors of the Chriſtian name, in the belief in one eternal God, the Creator and Preſerver of the univerſe; and in Jeſus Chriſt his Son, the Meſſiah, and Mediator of the new covenant (Heb. xii. 24).

"When we ſpeak of the gracious diſplay of the love of God to mankind, in the miraculous conception, birth, life, miracles, death, reſurrection, and aſcenſion of our Saviour, we prefer the uſe of ſuch terms as we find in Scripture; and, contented with that knowledge which divine wiſdom hath ſeen meet to reveal, we attempt not to explain thoſe myſteries which remain under the veil; nevertheleſs, we acknowledge and aſſert the divinity of Chriſt, who is the wiſdom and power of God unto ſalvation (1 Cor. i. 24).

"To Chriſt alone we give the title of the Word of God (John i. 1.) and not to the Scriptures; although we highly eſteem theſe ſacred writings, in ſubordination to the Spirit (2. Pet. i. 21.), from which they were given forth; and we hold, with the apoſtle Paul, that they are able to make wiſe unto ſalvation, through faith which is in Chriſt Jeſus (2 Tim. iii. 15).

"We reverence thoſe moſt excellent precepts which are recorded in ſcripture to have been delivered by our great Lord, and we firmly believe that they are practicable, and binding on every Chriſtian; and that in the life to come every man will be rewarded according to his works (Mat. xvi. 27). And farther, it is our belief, that, in order to enable mankind to put in practice theſe ſacred precepts, many of which are contradictory to the unregenerate will of man (John i. 9.), every man coming into the world is endued with a meaſure of the light, grace, or good Spirit of Chriſt; by which, as it is attended to, he is enabled to diſtinguiſh good from evil, and to correct the diſorderly paſſions and corrupt propenſities of his nature, which mere reaſon is altogether inſufficient to overcome. For all that belongs to man is fallible, within the reach of temptation; but this divine grace, which comes by Him who hath overcome the world (John xvi. 33.) is, to thoſe who humbly and ſincerely ſeek it, an all-ſufficient and preſent help in time of need. By this the ſnares of the enemy are detected, his allurements avoided, and deliverance is experienced through faith in its effectual operation; whereby the ſoul is tranſlated out of the kingdom of darkneſs, and from under the power of Satan, into the marvellous light and kingdom of the Son of God.

"Being thus perſuaded that man, without the Spirit of Chriſt inwardly revealed, can do nothing to the glory of God, or to effect his own ſalvation; we think this influence eſpecially neceſſary to the performance of the higheſt act of which the human mind is capable, even the worſhip of the Father of lights and of ſpirits, in ſpirit and in truth; therefore we conſider as obſtructions to pure worſhip, all forms which divert the attention of the mind from the ſecret influence of this unction from the Holy One (1 John ii. 20, 27). Yet, although true worſhip is not confined to time and place, we think it incumbent on Chriſtians to meet often together (Heb x. 25.) in teſtimony of their dependence on the heavenly Father, and for a renewal of their ſpiritual ſtrength: nevertheleſs, in the performance of worſhip, we dare not depend, for our acceptance with Him, on a formal repetition of the words and experiences of others; but we believe it to be our duty to ceaſe from the activity of the imagination, and to wait in ſilence to have a true ſight of our condition beſtowed upon us: believing even a ſingle ſigh (Rom. viii. 26.) ariſing from ſuch a ſenſe of our infirmities, and of the need we have of divine help, to be more acceptable to God, than any performances, however ſpecious, which originate in the will of man.

"From what has been ſaid reſpecting worſhip, it follows, that the miniſtry we approve muſt have its origin from the ſame ſource: for that which is needful for a man's own direction, and for his acceptance with God (Jer. xxiii. 30, to 32.) muſt be eminently ſo to enable him to be helpful to others. Accordingly, we believe the renewed aſſiſtance of the light and power of Chriſt to be indiſpenſably neceſſary for all true miniſtry; and that this holy influence is not at our command, or to be procured by ſtudy, but is the free gift of God to his choſen and devoted ſervants.—From hence ariſes our teſtimony againſt preaching for hire, and in contradiction to Chriſt's poſitive command, "Freely ye have received, freely give;" (Mat. x. 8.) and hence our conſcientious refuſal to ſupport ſuch miniſtry by tithes or other means.

"As we dare not encourage any miniſtry but that which we believe to ſpring from the influence of the Holy Spirit, ſo neither dare we attempt to reſtrain this influence to perſons of any condition in life, or to the male ſex alone; but, as male and female are one in Chriſt, we allow ſuch of the female ſex as we believe to be endued with a right qualification for the miniſtry, to exerciſe their gifts for the general edification of the church: and this liberty we eſteem to be a peculiar mark of the goſpel diſpenſation, as foretold by the prophet Joel (Joel ii. 28, 29.) and noticed by the apoſtle Peter (Acts ii. 16, 17).

"There are two ceremonies in uſe amongſt moſt profeſſors of the Chriſtian name; Water baptiſm, and what is termed the Lord's Supper. The firſt of theſe is generally eſteemed the eſſential means of initiation into the church of Chriſt; and the latter of maintaining communion with him. But as we have been convinced, that nothing ſhort of his redeeming power, inwardly revealed, can ſet the ſoul free from the thraldom of ſin, by this power alone we believe ſalvation to be effected. We hold that as there is one Lord and one faith (Eph. iv. 5.), ſo his baptiſm is one in nature and operation; that nothing ſhort of it can make us living members of his myſtical body; and that the baptiſm with water, adminiſtered by his fore-runner John, belonged, as the latter confeſſed, to an inferior and decreaſing diſpenſation (John iii. 30).

"With reſpect to the other rite, we believe that communion between Chriſt and his church is not maintained by that nor any other external performance, but only by a real participation of his divine nature (2. Pet. i. 4) through faith; that this is the ſupper alluded to in the Revelation (Rev. iii. 20.), "Behold I ſtand at the door and knock, if any man hear my voice, and open the door, I will come in to him, and will ſup with him, and he with me," and that where the ſubſtance is attained, it is unneceſſary to attend to the ſhadow, which doth not confer grace, and concerning which opinions ſo different, and animoſities ſo violent, have ariſen.

"Now, as we thus believe that the grace of God, which comes by Jeſus Chriſt, is alone ſufficient for ſalvation, we can neither admit that it is conferred on a few only, whilſt others are left without it; nor, thus aſſerting its univerſality, can we limit its operation to a partial cleanſing of the ſoul from ſin, even in this life. We entertain worthier notions both of the power and goodneſs of our heavenly Father, and believe that he doth vouchſafe to aſſiſt the obedient to experience a total ſurrender of the natural will to the guidance of his pure unerring Spirit; through whoſe renewed aſſiſtance they are enabled to bring forth fruits unto holineſs, and to ſtand perfect in their preſent rank (Mat. v. 48.; Eph. iv. 13.; Col. iv. 12.)

"There are not many of our tenets more generally known than our teſtimony againſt oaths and againſt war. With reſpect to the former of theſe, we abide literally by Chriſt's poſitive injunction, delivered in his ſermon on the mount, "Swear not at all" (Mat. v. 34)*. From the ſame ſacred collection of the moſt excellent precepts of moral and religious duty, from the example of our Lord himſelf (Mat. ch. v. 39, 44, &c. ch. xxvi. 52, 53.; Luke xxii. 51.; John xviii. 11.), and from the correſpondent convictions of his Spirit in our hearts, we are confirmed in the belief that wars and fightings are, in their origin and effects, utterly repugnant to the Goſpel, which ſtill breathes peace and good-will to men. We alſo are clearly of the judgment, that if the benevolence of the Goſpel were generally prevalent in the minds of men, it would effectually prevent them from oppreſſing, much more from enſlaving, their brethren, (of whatever colour or complexion), for whom, as for themſelves, Chriſt died; and would even influence their conduct in their treatment of the brute creation, which would no longer groan the victims of their avarice, and of their falſe ideas of pleaſure.

"Some of our tenets have in former times, as hath been ſhown, ſubjected our friends to much ſuffering from government, though to the ſalutary purpoſes of government our principles are a ſecurity. They inculcate ſubmiſſion to the laws in all caſes wherein conſcience is not violated. But we hold, that as Chriſt's kingdom is not of this world, it is not the buſineſs of the civil magiſtrate to interfere in matters of religion; but to maintain the external peace and good order of the community. We therefore think perſecution, even in the ſmalleſt degree, unwarrantable. We are careful in requiring our members not to be concerned in illicit trade, nor in any manner to defraud the revenue.

"It is well known that the ſociety, from its firſt appearance, has diſuſed thoſe names of the months and days which, having been given in honour of the heroes or falſe gods of the heathens, originated in their flattery or ſuperſtition; and the cuſtom of ſpeaking to a ſingle perſon in the plural number (B), as having ariſen alſo from motives of adulation. Compliments, ſuperfluity of apparel and furniture, outward ſhows of rejoicing and mourning, and obſervation of days and times, we eſteem to be incompatible with the ſimplicity and ſincerity of a Chriſtian life; and public diverſions, gaming, and other vain amuſements of the world, we cannot but condemn. They are a waſte of that time which is given us for nobler purpoſes, and divert the attention of the mind from the ſober duties of life, and from the reproofs of inſtruction, by which we are guided to an everlaſting inheritance.

"To conclude, although we have exhibited the ſeveral tenets which diſtinguiſh our religious ſociety, as objects of our belief, yet we are ſenſible that a true and living faith is not produced in the mind of man by his own effort; but is the free gift of God (Eph. ii. 8.) in Chriſt Jeſus, nouriſhed and increaſed by the progreſſive operation of his ſpirit in our hearts, and our proportionate obedience (John vii. 17.) Therefore, although, for the preſervation of the teſtimonies given us to bear, and for the peace and good order of the ſociety, we deem it neceſſary that thoſe who are admitted into memberſhip with us, ſhould be previouſly convinced of thoſe doctrines which we eſteem eſſential; yet we require no formal ſubſcription to any articles, either as the condition of memberſhip, or to qualify for the ſervice of the church. We prefer the judging of men by their fruits, in a dependence on the aid of Him who, by his prophet, hath promiſed to be "a ſpirit of judgment to him that ſitteth in judgment" (Iſaiah xxviii. 6.) Without this, there is a danger of receiving numbers into outward communion, without any addition to that ſpiritual ſheepfold, whereof our bleſſed Lord declared himſelf to be both the door and the ſhepherd (John x. 7, 11.) that is, ſuch as know his voice, and follow him in the paths of obedience."

Such are the doctrines of this people as we find them ſtated in a ſmall pamphlet lately preſented by themſelves to the public; and in the ſame tract they give the following account of their diſcipline.

"In the practice of diſcipline, we think it indiſpenſable that the order recommended by Chriſt himſelf be invariably obſerved: (Matth. xviii. 15. to 17.) 'If thy brother ſhall treſpaſs againſt thee, go and tell him his fault between thee and him alone: if he ſhall hear thee, thou haſt gained thy brother; but if he will not hear thee, then take with thee one or two more, that in the mouth of two or three witneſſes every word may be eſtabliſhed; and if he ſhall neglect to hear them, tell it unto the church.'

"To effect the ſalutary purpoſes of diſcipline, meetings were appointed, at an early period of the ſociety, which, from the times of their being held, were called quarterly-meetings. It was afterwards found expedient to divide the diſtricts of thoſe meetings, and to meet more often; whence aroſe monthly-meetings, ſubordinate to thoſe held quarterly. At length, in 1669, a yearly-meeting was eſtabliſhed, to ſuperintend, aſſiſt, and provide, rules for the whole; previous to which, general meetings had been occaſionally held.

"A monthly-meeting is uſually compoſed of ſeveral particular congregations, ſituated within a convenient diſtance of each other. Its buſineſs is to provide for the ſubſiſtence of their poor, and for the education of their offspring; to judge of the ſincerity and fitneſs of perſons appearing to be convinced of the religious principles of the ſociety, and deſiring to be admitted into

* See Oath.

(B) Speaking of this cuſtom, Fox ſays: "When the Lord ſent me into the world, he forbad me to put off my hat to any; and I was required to *thee* and *thou* all men and women." *Journal*, p. 24.

Quaker.

into memberſhip; to excite due attention to the diſcharge of religous and moral duty; and to deal with diſorderly members. Monthly-meetings alſo grant to ſuch of their members as remove into other monthly meetings, certificates of their memberſhip and conduct; without which they cannot gain memberſhip in ſuch meetings. Each monthly-meeting is required to appoint certain perſons under the name of *overſeers*, who are to take care that the rules of our diſcipline be put in practice; and when any caſe of complaint or diſorderly conduct comes to their knowledge, to ſee that private admonition, agreeable to the goſpel rule beforementioned, be given previous to its being laid before the monthly-meeting.

“ When a caſe is introduced, it is uſual for a ſmall committee to be appointed to viſit the offender, to endeavour to convince him of his error, and to induce him to forſake and condemn it. If they ſucceed, the perſon is by minute declared to have made ſatisfaction for the offence; if not, he is diſowned as a member of the ſociety.

“ In diſputes between individuals, it has long been the decided judgement of the ſociety that its members ſhould not ſue each other at law. It therefore enjoins all to end their differences by ſpeedy and impartial arbitration, agreeable to rules laid down. If any refuſe to adopt this mode, or, having adopted it, to ſubmit to the award, it is the direction of the yearly-meeting that ſuch be diſowned.

“ To monthly-meetings alſo belongs the allowing of marriages; for our ſociety hath always ſcrupled to acknowledge the excluſive authority of the prieſts in the ſolemnization of marriage. Thoſe who intend to marry, appear together and propoſe their intention to the monthly-meeting; and if not attended by their parents or guardians, produce a written certificate of their conſent, ſigned in the preſence of witneſſes. The meeting then appoints a committee to enquire whether they are clear of other engagements reſpecting marriage; and if at a ſubſequent meeting to which the parties alſo come and declare the continuance of their intention, no objections are reported, they have the meeting's conſent to ſolemnize their intended marriage. This is done in a public meeting, for worſhip; towards the cloſe whereof the parties ſtand up, and ſolemnly take each other for huſband and wife. A certificate of the proceeding is then publicly read, and ſigned by the parties, and afterwards by the relations and others as witneſſes. Of ſuch certificates the monthly-meeting keeps a record; as alſo of the births and burials of its members. A certificate of the date, of the name of the infant, and of its parents, ſigned by thoſe preſent at the birth, is the ſubject of one of theſe laſt-mentioned records; and an order for the interment, counterſigned by the grave-maker, of the other. The naming of children is without ceremony. Burials are alſo conducted in a ſimple manner. The body, followed by the relations and friends, is ſometimes, previouſly to interment, carried to a meeting; and at the grave a pauſe is generally made; on both which occaſions it frequently falls out that one or more friends preſent have ſomewhat to expreſs for the edification of thoſe who attend; but no religious rite is conſidered as an eſſential part of burial.

“ Several monthly-meetings compoſe a quarterly-meeting. At the quarterly meeting are produced written anſwers from the monthly-meetings, to certain queries reſpecting the conduct of their members, and the meeting's care over them. The accounts thus received are digeſted into one, which is ſent, alſo in the form of anſwers to queries, by repreſentatives, to the yearly-meeting.—Appeals from the judgement of monthly-meetings are brought to the quarterly-meetings; whoſe buſineſs alſo it is to aſſiſt in any difficult caſe, or where remiſſneſs appears in the care of the monthly-meetings over the individuals who compoſe them.

“ The yearly-meeting has the general ſuperintendance of the ſociety in the country in which it is eſtabliſhed (c); and therefore, as the accounts which it receives diſcover the ſtate of inferior meetings, as particular exigencies require, or as the meeting is impreſſed with a ſenſe of duty, it gives forth its advice, makes ſuch regulations as appear to be requiſite, or excites to the obſervance of thoſe already made; and ſometimes appoints committees to viſit thoſe quarterly-meetings, which appear to be in need of immediate help. Appeals from the judgement of quarterly-meetings are here finally determined; and a brotherly correſpondence, by epiſtles, is maintained with other yearly-meetings.

“ In this place it is proper to add, that as we believe women may be rightly called to the work of the miniſtry, we alſo think, that to them belongs a ſhare in the ſupport of our Chriſtian diſcipline; and that ſome parts of it, wherein their own ſex is concerned, devolve on them with peculiar propriety. Accordingly they have monthly, quarterly, and yearly-meetings of their own ſex, held at the ſame time and in the ſame place with thoſe of the men: but ſeparately, and without the power of making rules: and it may be remarked, that during the perſecutions, which in the laſt century occaſioned the impriſonment of ſo many of the men, the care of the poor often fell on the women, and was by them ſatisfactorily adminiſtered.

“ In order that thoſe who are in the ſituation of miniſters may have the tender ſympathy and counſel of thoſe of either ſex, who, by their experience in the work of religion, are qualified for that ſervice; the monthly-meeting are adviſed to ſelect ſuch, under the denomination of *elders*. Theſe, and miniſters approved by their monthly-meetings (d), have meetings peculiar to themſelves, called meetings of miniſters and elders;

(c) “ There are ſeven yearly-meetings, viz. 1ſt, London, to which come repreſentatives from Ireland; 2d, New-England; 3d, New-York; 4th, Pennſylvania and New-Jerſey; 5th, Maryland; 6th, Virginia; 7th the Carolinas and Georgia.”

(d) “ Thoſe who believe themſelves required to ſpeak in meetings for worſhip, are not immediately acknowledged as miniſters by their monthly-meetings; but time is taken for judgement, that the meeting may be ſatisfied of their call and qualification. It will alſo ſometimes happen, that ſuch as are not approved, will obtrude themſelves as miniſters, to the grief of their brethern; but much forbearance is uſed towards theſe, before the diſapprobation of the meeting is publicly teſtified.”

in which they have an opportunity of exciting each other to a diſcharge of their ſeveral duties, and of extending advice to thoſe who may appear weak, without any needleſs expoſure. Theſe meetings are generally held in the compaſs of each monthly, quarterly, and yearly-meeting. They are conducted by rules preſcribed by the yearly-meeting, and have no authority to make any alteration or addition to them. The members of them unite with their brethren in the meetings for diſcipline, and are equally accountable to the latter for their conduct.

"It is to a meeting of this kind held in London, called the ſecond-day morning-meeting, that the reviſal of manuſcripts concerning our principles, previouſly to publication, is intruſted by the yearly-meeting held in London; and alſo the granting, in the intervals of the yearly-meeting, certificates of approbation to ſuch miniſters as are concerned to travel in the work of the miniſtry in foreign parts. When a viſit of this kind doth not extend beyond Great Britain, a certificate from the monthly-meeting of which the miniſter is a member is ſufficient; if to Ireland, the concurrence of the quarterly-meeting is alſo required. Regulations of ſimilar tendency obtain in other yearly-meetings.

"The yearly-meeting held in London, in the year 1675, appointed a meeting to be held in that city, for the purpoſe of adviſing and aſſiſting in caſes of ſuffering for conſcience ſake, which hath continued with great uſe to the ſociety to this day. It is compoſed of friends under the name of correſpondents, choſen by the ſeveral quarterly-meetings, and who reſide in or near the city. The ſame meetings alſo appoint members of their own in the country as correſpondents, who are to join their brethren in London on emergency. The names of all theſe correſpondents, previous to their being recorded as ſuch, are ſubmitted to the approbation of the yearly-meeting. Thoſe of the men who are approved miniſters are alſo members of this meeting, which is called the *meeting* for *ſufferings;* a name ariſing from its original purpoſe, which is not yet become entirely obſelete.

"The yearly-meeting has intruſted the meeting for ſufferings with the care of printing and diſtributing books, and with the management of its ſtock; and conſidered as a ſtanding committee of the yearly-meeting, it hath a general care of whatever may ariſe, during the intervals of the meeting, affecting the ſociety, and requiring immediate attention: particularly of thoſe circumſtances which may occaſion an application to government.

"There is not in any of the meetings which have been mentioned any preſident, as we believe that Divine Wiſdom alone ought to preſide; nor hath any member a right to claim pre-eminence over the reſt. The office of clerk, with a few exceptions, is undertaken voluntarily by ſome member; as is alſo the keeping of the records. Where theſe are very voluminous, and require a houſe for their depoſite (as is the caſe in London, where the general records of the ſociety in Great Britain are kept), a clerk is hired to have the care of them; but except a few clerks of this kind, and perſons who have the care of meeting-houſes, none receive any ſtipend or gratuity for their ſervices in our religious ſociety."

It is remarkable, that all the ſettlements of the Europeans in America, except the Quaker ſettlement of Pennſylvania, were made by force of arms, with very little regard to any prior title in the natives. The kings of Spain, Portugal, France, and Britain, together with the States of Holland, then the only maritime powers, gave grants of ſuch parts of America as their people could lay hold on, ſtudying only to avoid interference with their European neighbours. But Mr Penn, being a Quaker, did not think his power from King Cha. II. a ſufficient title to the country ſince called *Pennſylvania:* He therefore aſſembled the ſachems or princes then in that country, and purchaſed from them the extent of land that he wanted. The government of this province was long in the hands of the quakers, who never have any quarrels with the natives. When they deſired to extend their ſettlements, they purchaſed new lands of the ſachems, never taking any thing from them by force. How unlike is this conduct to that of the Spaniards, who murdered millions of the natives of Mexico, Terra Firma, Peru, Chili, &c.

QUALITY is a word which, as uſed in philoſophical diſquiſitions, cannot be explained by any periphraſis. That which is expreſſed by it muſt be brought into the immediate view of the ſenſes or intellect, and the name properly applied, or he who is a ſtranger to the word will never be made to comprehend its meaning. Ariſtotle, who treated it as a general conception ſecond in order among the ten *predicaments* or *categories* (ſee CATEGORY), gives ſeveral characters of it; but though they are all in ſome reſpects juſt, no man could from them, without other aſſiſtance, learn what *quality* is. Thus he tells us*, Υ'παρχει δε εναντιοτης κατα το ποιον; Επιδεχεται δε το μαλλον και το ἧττον τα ποια. And again, Ο'μοια δε η ανομοια κατα μονας τας ποιοτητας λεγεται· ὁμοιον γαρ ἑτερον ἑτερω ουκ εστι κατ' αλλο ουδεν, η καθ' ὁ ποιον εστιν.

1
Quality characterized by Ariſtotle.

When a man comprehends, by means of his ſenſes and intellect, what it is which the word *quality* denotes, he will indeed perceive that the firſt of theſe characters is applicable to ſome qualities and not to others; that the ſecond is more applicable to *quantity* than to quality; and that it is only the third which can with propriety be conſidered as the general characteriſtic of this predicament. Thus when we have learned by our ſenſe of ſight that *whiteneſs* is a quality of ſnow, and *blackneſs* of coal; and by means of obſervation and reflection, that *wiſdom* is a quality of one man and *folly* of another—we muſt admit that the ſenſible quality of the ſnow is *contrary* to that of the coal, and the intellectual quality of wiſdom contrary to that of folly. There is, however, no contrariety between *wiſdom* and *whiteneſs* or *blackneſs*, nor between *hardneſs* or *ſoftneſs*, and *any particular colour;* for ſenſible and intellectual qualities can never be compared; and it is not eaſy, if poſſible, to make a compariſon between qualities perceptible only by different ſenſes: Nay, among qualities perceptible by the ſame ſenſe, we often meet with a difference where there is no contrariety; for though the *figure* of a *cube* is *different* from that of a *ſphere*, and the figure of a *ſquare* from that of a *circle*, the ſphere is not *contrary* to the cube, nor the circle to the ſquare.

His ſecond characteriſtic of this genus is ſtill leſs proper than the firſt. It is indeed true that ſome qualities admit of *intenſion* and *remiſſion;* for ſnow is whiter than paper, and one woman is handſomer than another; but of the ſpecies of quality called *figure* we cannot predicate either *more* or *leſs*. A crown-piece may have as much of the *circular quality* in it as the plane of the equator, and a muſket-bullet as much of the *ſpherical quality* as the orb of the ſun. It is indeed a property of all *quantity* to admit of *intenſion* and *remiſſion*; and therefore this ought to have been given as the character not of the ſecond but of the third category. See QUANTITY.

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* Præd. ed. Sylb. p. 44. 45.

2 Nothing known but qualities.

That it is only from a *compariſon of their qualities that things are denominated like or unlike* or that *one thing cannot reſemble another but in ſome quality*, is indeed a juſt obſervation. We know nothing directly but qualities ſenſible and intellectual (ſee METAPHYSICS, n° 149, 150, 151, and 227); and as theſe have no reſemblance to each other, we conclude that body or matter, the ſubject of the former, is a being unlike mind, the ſubject of the latter. Even of bodies themſelves we can ſay, that one is like or unlike another only by virtue of their qualities. A ball of ivory reſembles a ball of ſnow in its *figure* and *colour*, but not in its *coldneſs* or *hardneſs*; a ball of lead may reſemble a ball of ſnow in its *figure* and *coldneſs*, but not in its *colour*; and a cube of ivory reſembles not a ball of lead either in *figure*, *colour*, or *coldneſs*. The mind of a brute reſembles that of a man in its powers of *ſenſation* and *perception*, but does not reſemble it in the powers of *volition* and *reaſoning*; or at leaſt, the reſemblance, in this latter inſtance, is very ſlight. All bodies reſemble one another in being ſolid and extended, and all minds in being more or leſs active. *Likeneſs* or *unlikeneſs* therefore is the univerſal characteriſtic of the category *quality*.

3 Important diſtinctions of quality.

Ariſtotle has other ſpeculations reſpecting quality, which are worthy of notice. He diſtinguiſhes between qualities which are *eſſential* and thoſe which are *accidental*; between qualities which are *natural* and thoſe which are *acquired*; and he ſpeaks of the qualities of *capacity* and thoſe of *completion*. *Extenſion* and *figure* in *general* are qualities eſſential to all bodies; but a *particular* extenſion, ſuch as an *inch* or an *ell*, and a *particular* figure, ſuch as a *cube* or a *ſphere*, are qualites accidental to bodies. Among the *natural* qualities of glaſs it is one to tranſmit objects of viſion; but to enlarge theſe objects is an *adventitious* or *acquired* quality. The ſame quality may be *natural* in one ſubſtance, as attraction in the magnet; and *acquired* in another, as the ſame attraction in the magnetic bar. *Docility* may be called a quality *natural* to the mind of man, ſcience an *acquired* one. To underſtand what he means by qualities of *capacity* and *completion*, it may be ſufficient to obſerve that every piece of iron has the qualities of a razor in *capacity*, becauſe it may be converted into ſteel, and formed into a razor: when it is ſo formed, it has, in the language of this ſage, the quality of a razor in *completion*. Among the qualities of *capacity* and *completion*, the moſt important, and what may lead to intereſting ſpeculations, is the reaſoning faculty of man. A *capacity* of reaſoning is eſſential to the human mind; but the *completion* of this capacity or *actual reaſoning* is not, otherwiſe *infants* and perſons *aſleep* would be excluded from the human ſpecies.

4 Overlooked by Locke.

Mr Locke has puzzled his readers, and perhaps himſelf, with a queſtion reſpecting the ſpecies of an idiot or changeling, whom he pronounces to be ſomething between a man and brute*. It is not often that we feel ourſelves inclined to regret Locke's ignorance of Ariſtotle's diſtinctions; but we cannot help thinking, that had the Britiſh philoſopher attended to the Stagyrite's account of qualities in *capacity* and qualities in *completion*, this perplexing queſtion would never have been ſtarted. It is juſtly obſerved in the *Eſſay on Human Underſtanding*, that of *real eſſences* we know nothing: but that every man ſelects a certain number of qualities which he has always perceived united in certain beings; and forming theſe into one complex conception, gives to this conception a *ſpecific* name, which he applies to every being in which he finds thoſe qualities united. This is undoubtedly the proceſs of the mind in forming genera and ſpecies; and as the excellent author refuſes the name of *man* to the changeling, it is obvious that the complex conception, to which he gives that name, muſt imply *rationality* or the *actual exerciſe* of reaſon. But this limitation will exclude many beings from the ſpecies *man*, whom Mr Locke certainly conſidered as men and women. Not to mention infants and perſons in ſound ſleep, how ſhall we claſs thoſe who, after having lived 30 or 40 years in the full exerciſe of reaſon, have been ſuddenly or by degrees deprived of it by ſome diſorder in the brain?

5 Strange conſequence of this overſight.

> From Marlb'rough's eyes the ſtreams of dotage flow;
> And Swift expires a driveller and a ſhow.
>
> JOHNSON.

But were the hero and the wit in thoſe deplorable circumſtances excluded from the human ſpecies, and claſſed between men and brutes? No ſurely; they were both acknowledged to be men, becauſe they were known to have the quality of reaſon in what Ariſtotle would have called *capacity*. Their dotage and drivelling originated from ſome diſorder in their bodies, probably in the region of the brain; and Locke himſelf contends that no defect in body is ſufficient to degrade a perſon from the rank of manhood. Again, lunatics have the exerciſe of reaſon, except at new and full moon. Are theſe unhappy beings ſometimes men and ſometimes a ſpecies by themſelves between men and brutes?

6 Fallacy of his doctrine reſpecting the human ſpecies.

It appears, therefore, that *not* the *actual exerciſe* of reaſon, but reaſon in *capacity*, ought to be included in the complex conception to which we give the ſpecific name of *man*, as ſome of the greateſt men that ever lived have been during parts of their lives deprived of the power of *actual reaſoning*. This, however, it will be ſaid, does not remove the difficulty; for the occaſional exerciſe of reaſon in lunatics, and the great exertions of it in ſuch men as Swift and Marlborough, ſhow that they had it in *capacity* at all times; whereas we have no evidence that changelings have even a *capacity* of reaſoning at any time, ſince they never do a rational action, nor ever utter a ſentence to the purpoſe. That we have no *direct* and *poſitive* evidence of the minds of changelings being capable of reaſoning, were they ſupplied with proper organs, muſt be granted; but the probabilities of their being ſo are many and great. We know by experience that the actual exerciſe of reaſon may be interrupted by an occaſional and accidental preſſure on the brain: and therefore we cannot doubt but that if this preſſure were rendered permanent by any wrong configuration of the ſkull given to it, in the womb, or in the act of being born into the world, an infant, with a mind capable of reaſoning by means of proper organs, would by this accident be rendered, through the whole of life, an idiot or changeling. That idiotiſm is cauſed by ſuch accidents, and is not the quality of an inferior mind occaſionally given to a human body, will at leaſt ſeem probable from the following conſiderations.

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* Book iv. ch. 4. § 13. &c.

7 True doctrine.

It does not appear that an animal body can live and move but while it is actuated by ſome mind. Whence then does the unborn infant derive its mind? It muſt be either immediately from God, or *ex traduce* from its parents; but if the mind of man be immaterial, it cannot be *ex traduce*. Now, as idiots are very few in number when compared with the rational part of the human ſpecies, and as God in the government of this world acts not by partial but by general laws; we muſt conclude that the law which he has eſtabliſhed reſpecting the union of mind and matter, is, that human bodies ſhall be animated with minds endowed with a capacity of reaſoning, and that thoſe who never exert this capacity are prevented by ſome ſuch accident as we have aſſigned.

For a further account of qualities, why they are ſuppoſed to inhere in ſome ſubject, together with the uſual diſtinction between the primary and ſecondary qualities of matter, ſee Metaphysics, Part II. Chap. I.

Chemical Qualities, thoſe qualities principally introduced by means of chemical experiments, as fumigation, amalgamation, cupellation, volatilization, precipitation, &c.

Quality, is alſo uſed for a kind of title given to certain perſons, in regard of their territories, ſigniories, or other pretenſions.

QUANGA. See Capra.

QUANG-ping-fou, a city in China, is ſituated in the northern part of the province of Pe-tcheli, between the provinces of Chang-tong and Ho-nan, and has nine cities of the third claſs dependent on it; all its plains are well watered by rivers. Among its temples, there is one dedicated to thoſe men who, as the Chineſe pretend, diſcovered the ſecret of rendering themſelves immortal.

QUANGSI, a province of China, bounded on the north by Koe-Tcheau and Hu-Quang; on the eaſt, by Yunan and Quantong; on the ſouth, by the ſame and Ton-quin; and on the weſt, by Yun-nan. It produces great plenty of rice, being watered by ſeveral large rivers. The ſouthern part is a flat country, and well cultivated; but the northern is full of mountains covered with trees. It contains mines of all ſorts; and there is a gold-mine lately opened. The capital town is Quie-ling

A very ſingular tree, ſays Groſier, grows in this province; inſtead of pith, is contains a ſoft pulp, which yields a kind of flour: the bread made of it is ſaid to be exceedingly good. Beſides paroquets, hedgehogs, porcupines, and rhinoceroſes, a prodigious number of wild animals, curious birds, and uncommon inſects, are found here.

This province contains 12 villages of the firſt claſs, and 80 of the ſecond and third.

QUANG-tong, a province of China, bounded on the eaſt by Kiang-ſi and Fokien; on the ſouth, by the ocean; and on the weſt, by Tonquin. This province is diverſified by valleys and mountains; and yields two crops of corn in a year. It abounds in gold, Jewels, ſilk, pearls, tin, quickſilver, ſugar, braſs, iron, ſteel, ſaltpetre, ebony, and ſeveral ſorts of odoriferous wood; beſides fruits of all ſorts proper to the climate. They have a prodigious number of ducks, whoſe eggs they hatch in ovens; and a tree, whoſe wood is remarkably hard and heavy, and thence called *iron-wood*. The mountains are covered with a ſort of oſiers which creep along the ground, and of which they make baſkets, hurdles, matts, and ropes.

Although the climate of this province is warm, the air is pure, and the people are robuſt and healthy. They are very induſtrious; and it muſt be allowed that they poſſeſs in an eminent degree the talent of imitation: if they are only ſhown any of the European works, they execute others like them with the moſt ſurpriſing exactneſs. This province ſuffered much during the civil wars; but at preſent it is one of the moſt flouriſhing in the empire; and, as it is at a great diſtance from court, its government is one of the moſt important. This province is divided into ten diſtricts, which contain 10 cities of the firſt claſs, and 84 of the ſecond and third. Canton is the capital town.

1 Quantity.

QUANTITY, as explained by the great Engliſh lexicographer, is that property of any thing which may be increaſed or diminiſhed. This interpretation of the *word* is certainly juſt, and for the purpoſes of common converſation it is ſufficiently determinate; but the man of ſcience may expect to find in a work like ours a definition of the *thing* ſignified. This, however, cannot be given him. A logical definition conſiſts of the *genus* under which the thing defined is ranked, and the *ſpecific* difference (ſee Logic, nº 20, &c.); but quantity is ranked under no genus. In that ſchool where ſuch definitions were moſt valued, it was conſidered as one of the ten *categories*, or general conceptions, under which all the objects of human apprehenſion were muſtered, like ſoldiers in an army (ſee Category and Philosophy, nº 22.) On this account, even Ariſtotle himſelf, who delighted in definitions, and was not eaſily deterred from a favourite purſuit, could not conſiſtently with his own rules attempt to define *quantity*. He characterized it, however, in ſeveral parts of his works; and particularly in the 15th chapter of the 4th book of his metaphyſics, where he gives the following account of the three firſt *categories*: Ταυτα μεν γαρ, ων μια ἡ ουσια. ὁμοια δ' ων ἡ ποιοτης μια ισα δε ων ποσον εν. "Things are the *ſame*, of which the substance is one: *ſimilar*, of which the quality is one; *equal*, of which the quantity is one. Again, he tells us*, that the chief characteriſtic of quantity is, that it may be denominated *equal* and *unequal*.

2 Characterized by Ariſtotle.

That any man can become wiſer by reading ſuch deſcriptions as theſe, none but an idolater of Ariſtotle will ſuppoſe. There is, indeed, no periphraſis by which we can explain what is meant by quantity to thoſe who have not previouſly formed ſuch a notion.—All that can be done by making the attempt is only to ſettle language, by ſtating exactly the caſes in which we uſe this word in the greateſt conformity to general cuſtom; for there is a laxneſs or careleſsneſs of expreſſion in the language of moſt men, and our notions are frequently communicated by ſpeech in a way by no means preciſe; ſo that it is often a great chance that the notions excited in the mind of the hearer are not exact counterparts of thoſe in the mind of the ſpeaker.

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* Præd. p. 34. edit. Sylb.

The underſtandings of men differ in nothing more remarkably than in their power of abſtraction, and of rapidly forming conceptions ſo general and ſimple as not to be clogged with diſtinguiſhing circumſtances, which may be different in different minds while uttering and hearing the ſame words: and it is of great conſequence to a man of ſcientific habits, either to cultivate, if poſſible, this talent, or to ſuperſede its uſe, by ſtudiouſly forming to himſelf notions of the moſt important *univerſals* in his own courſe of contemplation, by careful abſtraction of every thing extraneous. His language by this means becomes doubly inſtructive by its extreme preciſion; and he will even judge with greater certainty of notions intended to be communicated by the more ſlovenly language of another perſon.

We cannot ſay that there is much ambiguity in the general uſe of the term *quantity*: But here, as in all other caſes, a love of refinement, of novelty, and frequently of vanity, and the wiſh of appearing ingenious and original, have made men take advantage of even the ſmall latitude with which the careleſs uſe of the word will furniſh them, to amuſe themſelves and the public by giving the appearance of ſcience to empty ſounds.

3
The ſubject of mathematical reaſoning.

Mathematics is undoubtedly employed in diſcovering and ſtating many relations of quantity; and it is in this category alone that any thing is contemplated by the mathematician, whether in geometry, arithmetic, or algebra. Hence mathematics has been called the ſcience of quantity. The ſimplicity of the object of the mathematician's contemplation, and the unparalleled diſtinctneſs with which he can perceive its modifications, have enabled him to erect a body of ſcience, eminent not only for its certainty, but alſo for the great length to which he can carry his reaſonings without danger of error; and the intimate connection which this ſcience has with the arts of life, and the important ſervices which it has performed, have procured it a moſt reſpectable place in the circle of the ſciences. Ingenious men have availed themſelves of this pre-eminence of mathematics, and have endeavoured to procure reſpect for their diſquiſitions on other ſubjects, by preſenting them to the public as branches of mathematical ſcience, and therefore ſuſceptible of that accuracy and certainty which are its peculiar boaſt. Our moral affections, our ſenſations, our intellectual powers, are all ſuſceptible of augmentation and diminution, are conceivable as greater and leſs when ſtated together, and are familiarly ſpoken of as admitting of degrees of compariſon. We are perfectly well underſtood when we ſay that one pain, heat, grief, kindneſs, is greater than another; and as this is the diſtinguiſhing characteriſtic of quantity, and as quantity is the ſubject of mathematical diſcuſſion, we ſuppoſe that theſe ſubjects may be treated mathematically. Accordingly, a very celebrated and excellent philoſopher* has ſaid, among many things of the ſame kind, that the greatneſs of a favour is in the direct compound ratio of the ſervice performed and the dignity of the performer, and the inverſe ratio of the merit and rank of the receiver; that the value of a character is in the compound ratio of the talents and virtue, &c.; and he has delivered a number of formal propoſitions on the moſt intereſting queſtions in morals, couched in this mathematical language, and even expreſſed by algebraic formulæ. But this is mere play, and conveys no inſtruction. We underſtand the words; they contain no abſurdity; and in as far as they have a ſenſe, we believe the propoſitions to be true. But they give no greater preciſion to our ſentiments than the more uſual expreſſions would do. If we attend cloſely to the meaning of any one of ſuch propoſitions, we ſhall find that it only expreſſes ſome vague and indiſtinct notions of degrees of thoſe emotions, ſentiments, or qualities, which would be juſt as well conceived by means of the expreſſions of ordinary language; and that it is only by a ſort of analogy or reſemblance that this mathematical language conveys any notions whatever of the ſubjects.

4
Which is improperly introduced into other ſubjects.

5
The mathematician contemplates only quantities that are meaſurable.

The object of contemplation to the mathematician is not whatever is ſuſceptible of greater and leſs, but what is meaſurable; and mathematics is not the ſcience of magnitude, in its moſt abſtracted and general acceptation, but of magnitude which can be meaſured. It is, indeed, the SCIENCE OF MEASURE, and whatever is treated in the way of menſuration is treated mathematically. Now, in the diſcourſe of ordinary life and ordinary men, many things are called quantities which we cannot or *do not* meaſure. This is the caſe in the inſtances already given of the affections of the mind, pleaſure, pain, beauty, wiſdom, honour, &c. We do not ſay that they are incapable of meaſure; but we have not yet been able to meaſure them, nor do we think of meaſuring them when we ſpeak rationally and uſefully about them. We therefore do not conſider them mathematically; nor can we introduce mathematical preciſion into our diſcuſſions of theſe ſubjects till we can, and actually do, meaſure them. Perſons who are preciſe in their expreſſion will even avoid ſuch phraſes on theſe ſubjects as ſuppoſe, or ſtrictly expreſs, ſuch meaſurement. We ſhould be much embarraſſed how to anſwer the queſtion, How much pain does the toothache give you juſt now; and how much is it eaſier ſince yeſterday? Yet the anſwer (if we had a meaſure) would be as eaſy as to the queſtion, How many guineas did you win at cards? or how much land have you bought? Nay, though we ſay familiarly, "I know well how much ſuch a misfortune would affect you," and are underſtood when we ſay it, it would be aukward language to ſay, "I know well the quantity of your grief." It is in vain, therefore, to expect mathematical preciſion in our diſcourſe or conceptions of quantities in the moſt abſtracted ſenſe. Such preciſion is confined to quantity which may be and is meaſured (A). It is only trifling with the imagination when we employ mathematical language on ſubjects which have not this property.

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* Dr Francis Hutchinſon.

(A) To talk intelligibly of the quantity of a pain, we ſhould have ſome ſtandard by which to meaſure it; ſome known degree of it ſo well aſcertained, that all men, when talking of it, ſhould mean the ſame thing.—And we ſhould be able to compare other degrees of pain with this, ſo as to perceive diſtinctly, not only whether they exceed or fall ſhort of it, but alſo how much, or in what proportion; whether by an half, or a fifth, or a tenth. *Reid.*

It will therefore be of ſome ſervice in ſcience to diſcriminate quantities in this view; to point out what are ſuſceptible of meaſure, and what are not.

6
Meaſuring explained.

What is meaſuring? It is one of theſe two things: It is either finding out ſome known magnitude of the thing meaſured, which we can demonſtrate to be equal to it; or to find a known magnitude of it, which being taken ſo many times ſhall be equal to it. The geometer meaſures the contents of a parabolic ſpace when he exhibits a parallelogram of known dimenſions, and demonſtrates that this parellogram is equal to the parabolic ſpace. In like manner, he meaſures the ſolid contents of an infinitely extended hyperbolic ſpindle, when he exhibits a cone of known dimenſions, and demonſtrates that three of theſe cones are equal to the ſpindle.

In this proceſs it will be found that he actually ſubdivides the quantity to be meaſured into parts of which it conſiſts, and ſtates theſe parts as actually making up the quantity, ſpecifying each, and aſſigning its boundaries. He goes on with it, piece by piece, demonſtrating the reſpective equalities as he goes along, till he has exhauſted the figure, or conſidered all its parts.—

When he meaſures by means of a ſubmultiple, as when he ſhows the ſurface of a ſphere to be equal to four of its great circles, he ſtops, after having demonſtrated the equality of one of theſe circles to one part of the ſurface: then he demonſtrates that there are other three parts, each of which is preciſely equal to the one he has minutely conſidered. In this part of the proceſs he expreſsly aſſigns the whole ſurface into its diſtinct portions, of which he demonſtrates the equality.

But there is another kind of geometrical meaſurement which proceeds on a very different principle. The geometer conceives a certain individual portion of his figure, whether line, angle, ſurface, or ſolid, as known in reſpect to its dimenſions. He conceives this to be lifted from its place, and again laid down on the *adjoining* part of the figure, and that it is equal to the part which it now covers; and therefore that this part together with the firſt is double of the firſt: he lifts it again, and lays it down on the next adjoining part, and affirms that this, added to the two former, make up a quantity triple of the firſt. He goes on in this way, making ſimilar inferences, till he can demonſtrate that he has in this manner covered the whole figure by twenty applications, and that his moveable figure will cover no more; and he affirms that the figure is twenty times the part employed.

7
Euclid's fourth propoſition.

This mode is preciſely ſimilar to the manner of practical meaſurement in common life: we apply a foot-rule ſucceſſively to two lines, and find that 30 applications exhauſt the one, while it requires 35 to exhauſt the other. We ſay, therefore, that the one line is 30 and the other 35 feet long; and that theſe two lines are to each other in the ratio of 30 to 35. Having meaſured two ſhorter lines by a ſimilar application of a ſtick of an inch long 30 times to the one and 35 times to the other, we ſay that the ratio of the two firſt lines is the ſame with that of the two laſt. Euclid has taken this method of demonſtrating the fourth propoſition of the firſt book of his celebrated elements.

But all this proceſs is a fiction of the mind, and it is the fiction of an impoſſibility. It is even *inconceivable*, that is, we cannot in imagination make this application of one figure to another; and we preſume to ſay, that, if the elements of geometry cannot be demonſtrated in ſome other way, the ſcience has not that title to pure, abſtract, and infallible knowledge, which is uſually allowed it. We cannot *ſuppoſe* one of the triangles lifted and laid on the other, without ſuppoſing it ſomething different from a triangle *in abſtracto*. The *individuality* of ſuch a triangle conſiſts ſolely in its being in the preciſe place where it is, and in occupying *that* portion of ſpace. If we could diſtinctly conceive otherwiſe, we ſhould perceive that, when we have lifted the triangle from its place, and applied it to the other, it is gone from its former place, and that there is no longer a triangle *there*. This is inconceivable, and ſpace has always been acknowledged to be immoveable. There is therefore ſome logical defect in Euclid's demonſtration. We apprehend that he is labouring to demonſtrate, or rather illuſtrate, a ſimple apprehenſion. This indeed is the utmoſt that can be done in any demonſtration (ſee METAPHYSICS, n° 82.): but the mode by which he guides the mind to the apprehenſion of the truth of his fourth propoſition is not conſiſtent either with pure mathematics or with the laws of corporeal nature. The real proceſs, as laid down by him, ſeems to be this. We ſuppoſe ſomething different from the abſtract triangle; ſome *thing* that, in conjunction with other properties has the property of being triangular, with certain dimenſions of two of its ſides and the included angle. It has avowedly another property, not eſſential to, and not contained in, the abſtract notion of a triangle, viz. mobility. We alſo ſuppoſe it permanent in ſhape and dimenſions, or that although, *during* its motion, it does not occupy *the ſame ſpace*, it continues and all its parts, to occupy *an equal ſpace*. In ſhort, our conception is very mixed, and does not perceptibly differ from our conception of a triangular piece of matter, where the triangle is not the ſubject, but an adjunct, a quality. And when we ſuppoſe the application made, we are not in fact ſuppoſing two abſtract triangles to coincide. This we cannot do with any thing like diſtinctneſs; for our diſtinct couception now is, not that of two triangles coinciding, but of one triangle being now exactly occupied by that moveable thing which formerly occupied the other. In ſhort, it is a vulgar meaſurement, reſtricted by ſuppoſitions which are inadmiſſible in all *actual* meaſurements in the preſent univerſe, in which no moveable material thing is *known* to be permanent, either in ſhape or magnitude.

This is an undeniable conſequence of the principle of univerſal gravitation, and the compreſſibility of every kind of tangible matter with which we are acquainted. Remove the braſs rule but one inch from its place; its gravitation to the earth and to the reſt of the univerſe is immediately changed, and its dimenſions change of conſequence. A change of temperature will produce a ſimilar effect; and this is attended to and conſidered in all nice menſurations. We do the beſt we can to aſſure ourſelves that our rule always occupies a ſenſibly equal ſpace; and we muſt be contented with chances of error which we can neither perceive nor remove.

We might (were this a proper place) take notice of ſome other logical defects in the reaſoning of this celebrated propoſition: but they are beſide our preſent purpoſe of explaining the different modes of mathematical

cal meaſurement, with the view of diſcovering that circumſtance in which they all agree, and which (if the only one) muſt therefore be the characteriſtic of menſuration.

8
The characteriſtic notion of menſuration.

We think that the only circumſtance in which all modes of menſuration agree, or the only notion that is found in them all, is, that the quantity is conceived as conſiſting of parts, diſtinguiſhable from each other, and ſeparated by aſſignable boundaries; ſo that they are at once conceived ſeparately and jointly. We venture to aſſert that no quantity is directly meaſured which we cannot conceive in this way, and that ſuch quantities only are the immediate objects of mathematical contemplation, and ſhould be diſtinguiſhed by a generic name. Let them be called MATHEMATICAL QUANTITIES. EXTENSION, DURATION, NUMBER, and PROPORTION, have this characteriſtic, and they are the only quantities which have it. Any perſon will be convinced of the firſt aſſertion by attending to his own thoughts when contemplating theſe notions. He will find that he conceives every one of them as made up of its own parts, which are diſtinguiſhable from each other, and have aſſignable boundaries, and that it is only in conſequence of involving this conception that they can be added to or ſubtracted from each other; that they can be multiplied, divided, and conceived in any proportion to each other.

He may perhaps find conſiderable difficulty in acquiring perfectly diſtinct notions of the menſurability, and the accuracy of the modes of menſuration. He will find that the way in which he meaſures duration is very ſimilar to that in which he meaſures ſpace or extenſion. He does not know, or does not attend to, any thing which hinders the braſs foot-rule in his hand from continuing to occupy equal ſpaces during his uſe of it, in meaſuring the diſtance of two bodies. In like manner he ſelects an event which nature or art can repeat continually, and in which the circumſtances which contribute to its accompliſhment are invariably the ſame, or their variations and their effects are inſenſible. He concludes that it will always occupy an equal portion of time for its accompliſhment, or always laſt an equal time. Then, obſerving that, during the event whoſe duration he wiſhes to meaſure, this ſtandard event is accompliſhed 29½ times, and that it is repeated 365¼ times during the accompliſhment of another event, he affirms that the durations of theſe are in the ratio of 29½ to 365¼. It is thus (and with the ſame logical defect as in the meaſuring a line by a braſs rod) that the aſtronomer meaſures the celeſtial revolutions by means of the rotation of the earth round its axis, or by the vibrations of a pendulum.

We are indebted for moſt of the preceding obſervations to Dr Reid, the celebrated author of the Inquiry into the Human Mind on the Principles of Common Senſe, and of the Eſſays on the intellectual and active powers of Man. He has publiſhed a diſſertation on this ſubject in the 45th volume of the Philoſophical Tranſactions, n° 489, which we recommend to our philoſophical readers as a performance eminent for preciſion and acuteneſs. If we preſume to differ from him in any trivial circumſtance, it is with that deference and reſpect which is due to his talents and his worth.

9
Characters of mathematical quantity.

Dr Reid juſtly obſerves, that as nothing has proportion which has not either extenſion, duration, or number, the characters of mathematical quantity may be reſtricted to theſe three. He calls them PROPER quantities, and all others he calls IMPROPER. We believe that, in the utmoſt preciſion of the Engliſh language, this denomination is very appoſite, and that the word *quantity*, derived from *quantum*, always ſuppoſes meaſurement: But the word is frequently uſed in caſes where its original is not kept in view, and we uſe other words as ſynonymous with it, when all menſuration, whether poſſible or not, is out of our thoughts. According to practice, therefore, the *jus et norma loquendi*, there ſeems to be no impropriety in giving this name, in our language at leaſt, to whatever can be conceived as great or little. There is no impropriety in ſaying that the pain occaſioned by the ſtone is greater than that of the toothache; and when we ſearch for the category to which the aſſertion may be referred, we cannot find any other than quantity. We may be allowed therefore to ſay, with almoſt all ſcientific men, that every thing is conceivable in reſpect of quantity which we can think or ſpeak of as greater and leſs; and that this notion is the characteriſtic of quantity as a genus, while meaſurableneſs is the characteriſtic of mathematical quantity as a ſpecies.

10
Other quantities that cannot be conſidered mathematically.

But do we not meaſure many quantities, and conſider them mathematically, which have not this characteriſtic of being made up of their own diſtinguiſhable parts? What elſe is the employment of the mechanician, when ſpeaking of velocities, forces, attractions, repulſions, magnetic influence, chemical affinity, &c. &c.? Are not theſe mathematical ſciences? And if the preciſion and certainty of mathematics ariſe from the nature of their ſpecific object, are not all the claims of the mechanician and phyſical aſtronomer ill-founded pretenſions? Theſe queſtions require and deſerve a ſerious anſwer.

11
Velocity, force, denſity, how meaſured.

It is moſt certain that we conſider the notions which are expreſſed by theſe terms velocity, force, denſity, and the like, as ſuſceptible of meaſure, and we conſider them mathematically.

Some of theſe terms are nothing but names for relations of meaſurable quantity, and only require a little reflection to ſhow themſelves ſuch. VELOCITY is one of theſe. It is only a name expreſſing a relation between the ſpace deſcribed by a moving body and the time which elapſes during its deſcription. Certain moderate rates of motion are familiar to us. What greatly exceeds this, ſuch as the flight of a bird when compared with our walking, excites our attention, and this exceſs gets a name. A motion not ſo rapid as we are familiar with, or as we wiſh, alſo gets a name; becauſe in this the exceſs or defect may intereſt us. We wiſh for the flight of the hawk; we chide the tardy pace of our meſſenger: but it is ſcientific curioſity which firſt conſiders this relation as a *ſeparate* object of contemplation, and the philoſopher muſt have a name for it. He has not formed a new one, but makes uſe of a word of common language, whoſe natural meaning is the combination of a great ſpace with a ſhort time. Having once appropriated it, in his ſcientific vocabulary, to this very general uſe, it loſes with him its true ſignification. Tardity would have done juſt as well, though its true meaning is diametrically oppoſite; and there is no greater impropriety in ſaying the tardity of a cannon bullet than in ſaying the velocity of the hour-hand of a watch.

Velocity is a quality or affection of motion, the notion of which includes the notions of ſpace and duration (two mathematical quantities), and no other. It does not therefore expreſs a mathematical quantity itſelf, but a relation, a combination of two mathematical quantities of different kinds; and as it is meaſurable in the quantities ſo combined, its meaſure muſt be a unit of its own kind, that is, an unit of ſpace *as combined* with an unit of time.

DENSITY is another word of the ſame kind, expreſſing a combination of ſpace with number. *Denſæ arbores* means trees ſtanding at a ſmall diſtance from each other; and the word is uſed in the ſame ſenſe when we ſay that quickſilver is denſer than water. The expreſſion always ſuggeſts to the reflecting mind the notions of particles and their diſtances. We are indeed ſo habituated to complicated views of things, that we can ſee remote connections with aſtoniſhing rapidity; and a very few circumſtances are ſufficient for leading forward the mind in a train of inveſtigation. Common diſcourſe is a moſt wonderful inſtance of this. It is in this way that we ſay, that we found by weighing them that inflammable air had not the ſixth part of the denſity of common air. Suppoſing all matter to conſiſt of equal atoms equally heavy, and knowing that the weight of a bladder of air is the ſum of the weights of all the atoms, and alſo knowing that the *vicinity* of the atoms is in a certain proportion of the *number* contained in a given bulk, we affirm that common air is more than ſix times denſer than inflammable air; but this rapid deciſion is entirely the effect of habit, which makes us familiar with certain groups of conceptions, and we inſtantaneouſly diſtinguiſh them from others, and thus think and diſcourſe rationally. The Latin language employs the word *frequens* to expreſs both the combination of ſpace and number, and that of time and number.

There are perhaps a few more words which expreſs combinations of mathematical quantities of different kinds; and the correſponding ideas or notions are therefore proper and immediate ſubjects of mathematical diſcuſſion: But there are many words which are expreſſive of things, or at leaſt of notions, to which this way of conſidering them will not apply. All thoſe affections or qualities of external bodies, by which they are conceived to act on each other, are of this kind: IMPULSIVE FORCE, WEIGHT, CENTRIPETAL AND CENTRIFUGAL FORCE, MAGNETICAL, ELECTRICAL, CHEMICAL ATTRACTIONS AND REPULSIONS; in ſhort, all that we conſider as the immediate cauſes of natural phenomena. Theſe we familiarly meaſure, and conſider mathematically.

12
Forces meaſured in the phenomena.

What was ſaid on this ſubject in the article PHYSICS will give us clear conceptions of this proceſs of the mind. Theſe forces or cauſes are not immediate objects of contemplation, and are known only *by* and *in* the phenomena which we conſider as their effects. The phenomenon is not only the indication of the agency of any cauſe, and the characteriſtic of its kind, but the meaſure of its degree. The neceſſary circumſtances in this *train of human thought* are, 1ſt, The notion of the force as ſomething ſuſceptible of augmentation and diminution. 2d, The notion of an inſeparable connection of the force with the effect produced, and of every degree of the one with a correſponding degree of the other. From theſe is formed the notion that the phenomenon or effect is the proper meaſure of the force or cauſe. All this is ſtrictly logical.

But when we are conſidering theſe ſubjects mathematically, the immediate objects of our contemplation are not the forces which we are thus treating. It is not their relations which we perceive, and which we combine with ſuch complication of circumſtances and certainty of inference as are unknown in all other ſciences; by no means; they are the phenomena only, which are ſubjects of purely mathematical diſcuſſion. They are motions, which involve only the notions of ſpace and time; and when we have finiſhed an accurate mathematical inveſtigation, and make our affirmation concerning the forces, we are certain of its truth, becauſe we *ſuppoſe* the forces to have the proportions and relations, and no other, which we obſerve in the phenomena. Thus, after having demonſtrated, by the geometrical compariſon of the lines and angles and ſurfaces of an ellipſe, that the momentary deflection of the moon from the tangent of her orbit is the 3600th part of the ſimultaneous deflection of a ſtone from the tangent of its parabolic path, Newton affirms, that the force by which a particle of the moon is retained in her orbit is the 3600th part of the weight of a particle of the ſtone; and having farther ſhown, from fact and obſervation, that theſe momentary deflections are inverſely as the ſquares of the diſtances from the centre of the earth, he affirms, that all this is produced by a force which varies its intenſity in this manner.

Now all this inveſtigation proceeds on the two ſuppoſitions mentioned above, and the meaſures of the forces are in fact the meaſures of the phenomena. The whole of phyſical aſtronomy, and indeed the whole of mechanical philoſophy, might be taught and underſtood, without ever introducing the word force, or the notion which it is ſuppoſed to expreſs: for our mathematical reaſonings are really about the phenomena, which are ſubjects purely mathematical.

The preciſion, therefore, that we preſume to affirm to attend theſe inveſtigations, ariſes entirely from the meaſurable nature of the quantities which are the real objects of our contemplation, and the ſuitableneſs and propriety of the meaſures which we adopt in our compariſons.

Since, then, the phenomena are the *immediate* ſubjects of our diſcuſſion, and the operating powers are only inferences from the phenomena conſidered as effects, the quantity aſcribed to them muſt alſo be an inference from the quantity of the effect, or of ſome circumſtance in the effect. The meaſure, therefore, of the cauſe, or natural power or force, cannot be one of its own parts; for the whole and the part are equally unperceived by us. Our meaſure, therefore, muſt be a meaſure of ſome intereſting part, or of the only intereſting part of the phenomenon. It is therefore in a manner arbitrary, and depends chiefly on the intereſt we take in the phenomenon. It muſt, however, be ſettled with preciſion, ſo that all men in uſing it may mean the ſame thing. It muſt be ſettled, therefore, by the deſcription of that part or circumſtance of the phenomenon which is characteriſtic of the natural power. This deſcription is the *definition* of the meaſure.

13
Meaſures of centripetal force.

Thus Newton aſſumes as his meaſure of the centripetal force, the momentary deviation from uniform rectilineal motion. Others, and ſometimes Newton himſelf, aſſumes the momentary change of velocity, which again is meaſured by *twice this deviation*. Theſe meaſures, being thus ſelected, are always proper in a mathematical ſenſe; and if ſtrictly adhered to, can never lead us into any paralogiſm. They may, however, be phyſically wrong: there may not be that indiſſoluble connection between the phenomenon and the ſuppoſed cauſe. But this is no mathematical error, nor does it invalidate any of our mathematical inferences: it only makes them uſeleſs for explaining the phenomenon by the principles which we adopted; but it prepares a modification of the phenomenon for ſome more fortunate application of phyſical principles.

14 Requiſites of ſuch meaſures.

All that can be deſired in the definitions or deſcriptions of theſe meaſures is, that they may not deviate from the ordinary uſe of the terms, becauſe this would always create confuſion, and occaſion miſtakes. Dr Reid has given an example of an impropriety of this kind, which has been the ſubject of much debate among the writers on natural philoſophy. We mean the meaſure of the force inherent in a body in motion. Deſcartes, and all the writers of his time, aſſumed the velocity produced in a body as the meaſure of the force which produces it; and obſerving that a body, in conſequence of its being in motion, produces changes in the ſtate or motion of other bodies, and that theſe changes are in the proportion of the velocity of the changing body, they aſſerted that there is in a moving body a VIS INSITA, an INHERENT FORCE, and that this is proportional to its velocity; ſaying that its force is twice or thrice as great, when it moves twice or thrice as faſt at one time as at another. But Leibnitz obſerved, that a body which moves twice as faſt, riſes four times as high, againſt the uniform action of gravity; that it penetrates four times as deep into a piece of uniform clay; that it bends four times as many ſprings, or a ſpring four times as ſtrong, to the ſame degree; and produces a great many effects which are four times greater than thoſe produced by a body which has half the initial velocity. If the velocity be triple, quadruple, &c. the effects are nine times, 16 times, &c. greater; and, in ſhort, are proportional, not to the velocity, but to its ſquare. This obſervation had been made before by Dr Hooke, who has enumerated a prodigious variety of important caſes in which this proportion of effect is obſerved. Leibnitz, therefore, affirmed, that the force inherent in a moving body is proportional to the ſquare of the velocity.

15 Controverſy between the Carteſians and Leibnitzians on this ſubject.

It is evident that a body, moving with the ſame velocity, has the ſame inherent force, whether this be employed to move another body, to bend ſprings, to riſe in oppoſition to gravity, or to penetrate a maſs of ſoft matter. Therefore theſe meaſures, which are ſo widely different, while each is agreeable to a numerous claſs of facts, are not meaſures of this ſomething inherent in the moving body which we call its force, but are the meaſures of its exertions when modified according to the circumſtances of the caſe; or, to ſpeak ſtill more cautiouſly and ſecurely, they are the meaſures of certain claſſes of phenomena conſequent on the action of a moving body. It is in vain, therefore, to attempt to ſupport either of them by a demonſtration. The meaſure itſelf is nothing but a definition. The Carteſian calls that a double force which produces a double velocity in the body on which it acts. The Leibnitzian calls that a quadruple force which makes a quadruple penetration. The reaſonings of both in the demonſtration of a propoſition in dynamics may be the ſame, as alſo the reſult, though expreſſed in different numbers.

But the two meaſures are far from being equally proper; for the Leibnitzian meaſure obliges us to do continual violence to the common uſe of words. When two bodies moving in oppoſite directions meet, ſtrike each other, and ſtop, all men will ſay that their forces are equal, becauſe they have the beſt teſt of equality which we can deviſe. Or when two bodies in motion ſtrike the parts of a machine, ſuch as the oppoſite arms of a lever, and are thus brought completely to reſt, we and all men will pronounce their mutual energies by the intervention of the machine to be equal. Now, in all theſe caſes, it is well known that a perfect equality is found in the products of the quantities of matter and velocity. Thus a ball of two pounds, moving with the velocity of four feet in a ſecond, will ſtop a ball of eight pounds moving with the velocity of one foot per ſecond. But the followers of Leibnitz ſay, that the force of the firſt ball is four times that of the ſecond.

All parties are agreed in calling gravity a uniform or invariable accelerating force; and the definition which they give of ſuch a force is, that it always produces the ſame acceleration, that is, equal accelerations in equal times, and *therefore* produces augmentations of velocity proportionable to the times in which they are produced. The only effect aſcribed to this force, and conſequently the only thing which indicates, characteriſes, and meaſures it, is the augmentation of velocity. What is this velocity, conſidered not merely as a mathematical term, but as a phenomenon, as an event, a production by the operation of a natural cauſe? It cannot be conceived any other way than as a *determination* to move on forever at a certain rate, if nothing ſhall change it. We cannot conceive this very clearly. We feel ourſelves forced to animate, as it were, the body, and give it not only a will and intention to move in this manner, but a real exertion of ſome faculty in conſequence of this determination of mind. We are conſcious of ſuch a train of operations in ourſelves; and the laſt ſtep of this train is the exertion or energy of ſome natural *faculty*, which we, in the utmoſt propriety of language, call force. By ſuch analogical conception, we ſuppoſe a ſomething, an energy, inherent in the moving body; and its only office is the production and continuation of this motion, as in our own caſe. Scientific curioſity was among our lateſt wants, and language was formed long before its appearance: as we formed analogical conceptions, we contented ourſelves with the words already familiar to us, and to this ſomething we gave the name FORCE, which expreſſed that energy in ourſelves which bears ſome reſemblance (in office at leaſt) to the determination of a body to move on at a certain rate. This ſort of allegory pervades the whole of our conceptions of natural operations, and we can hardly think or ſpeak of any operation without a language, which ſuppoſes the animation of matter. And, in the preſent caſe, there are ſo many points of reſemblance between the effects of our exertions and the operations of nature, that the language is moſt expreſſive, and has the ſtrongeſt appearance of propriety. By exerting our force, we not only move and keep in motion, but we move other bodies. Juſt ſo a ball not only moves, but puts other bodies in motion, or penetrates them, &c.—This is the origin of that conception which ſo forcibly obtrudes itſelf into our thoughts, that there is inherent in a moving body a force by which it produces changes in other bodies. No ſuch thing appears in the ſame body if it be not in motion. We therefore conclude, that it is the production of the moving force, whatever that has been. If ſo, it muſt be conceived as proportional to its producing cauſe. Now this force, thus produced or exerted in the moving body, is only another way of conceiving that determination which we call velocity, when it is conceived as a natural event. We can form no other notion of it. The *vis inſita*, the determination to move at a certain rate, and the velocity, are one and the ſame thing, conſidered in different relations.

16 Vis inſita.

Therefore the *vis inſita corpori moventi*, the determination to move at a certain rate, and the velocity, ſhould have one and the ſame meaſure, or any one of them may be taken for the meaſure of the other. The velocity being an object of perception, is therefore a proper meaſure of the inherent force; and the propriety is more evident by the perfect agreement of this uſe of the words with common language. For we conceive and expreſs the action of gravity as uniform, when we think and ſay that its effects are proportional to the times of its action. Now all agree, that the velocity produced by gravity is proportional to the time of its action. And thus the meaſure of force, in reference to its producing cauſe, perfectly agrees with its meaſure, independent of this conſideration.

But this agreement is totally loſt in the Leibnitzian doctrine; for the body which has fallen four times as far, and has ſuſtained the action of gravity twice as long, is ſaid to have four times the force.

17 Conſervatio virium vivarum.

The quaintneſs and continual paradox of expreſſion which this meaſure of inherent force leads us into, would have quickly exploded it, had it not been that its chief abettors were leagued in a keen and acrimonious warfare with the Britiſh mathematicians who ſupported the claim of Sir Iſaac Newton to the invention of fluxions. They rejoiced to find in the elegant writings of Huyghens a phyſical principle of great extent, ſuch as this is, which could be ſet in compariſon with ſome of the wonderful diſcoveries in Newton's Principia. The fact, that in the mutual actions of bodies on each other the products of the maſſes and the ſquares of the velocities remain always the ſame (which they call the *conſervatio virium vivarum)*, is of almoſt univerſal extent; and the knowledge of it enabled them to give ready and elegant ſolutions of the moſt abſtruſe and intricate problems, by which they acquired a great and deſerved celebrity. Dr Robert Hooke, whoſe obſervation hardly any thing eſcaped, was the firſt (long before Huyghens) who remarked*, that in all the caſes of the gradual production and extinction of motion, the ſenſible phenomenon is proportional to the ſquare of the produced or extinguiſhed velocity.

18 Law of continuity.

John Bernoulli brought all theſe facts together, and ſyſtematized them according to the principle advanced by Huyghens in his treatiſe on the centre of oſcillation. He and Daniel Bernoulli gave moſt beautiful ſpecimens of the prodigious uſe of this principle for the ſolution of difficult phyſical problems in their diſſertations on the motion and impulſe of fluids, and on the communication of motion. It was however very early objected to them (we think by Marquis Poleni), that in the colliſion of bodies perfectly hard there was no ſuch *conſervatio virium vivarum;* and that, in this caſe, the forces muſt be acknowledged to be proportional to the velocities. The objections were unanſwerable.—But John Bernoulli evaded their force, by affirming that there were and could be no bodies perfectly hard. This was the origin of another celebrated doctrine, on which Leibnitz greatly plumed himſelf, THE LAW OF CONTINUITY, viz that nothing is obſerved to change abruptly, or *per ſaltum*. But no one will pretend to ſay that a perfectly hard body is an inconceivable thing; on the contrary, all will allow that ſoftneſs and compreſſibility are adjunct ideas, and not in the leaſt neceſſary to the conception of a particle of matter, nay totally incompatible with our notion of an ultimate atom.

19 Great ſuperiority of Newton.

Sir Iſaac Newton never could be provoked to engage in this diſpute. He always conſidered it as a wilful abuſe of words, and unworthy of his attention. He guarded againſt all poſſibility of cavil, by giving the moſt preciſe and perſpicuous definitions of thoſe meaſures of forces, and all other quantities which he had occaſion to conſider, and by carefully adhering to them. And in one propoſition of about 20 lines, viz. the 39th of the 1ſt book of the Principia, he explained every phenomenon adduced in ſupport of the Leibnitzian doctrine, ſhowing them to be immediate conſequences of the action of a force meaſured by the velocity which it produces or extinguiſhes. There it appears that the heights to which bodies will riſe in oppoſition to the uniform action of gravity are as the ſquares of the initial velocities: So are the depths to which they will penetrate uniformly reſiſting matter: So is the number of equal ſprings which they will bend to the ſame degree, &c. &c. &c. We have had frequent occaſion to mention this propoſition as the moſt extenſively uſeful of all Newton's diſcoveries. It is this which gives the immediate application of mechanical principles to the explanation of natural phenomena. It is inceſſantly employed in every problem by the very perſons who hold by the other meaſure of forces, although ſuch conduct is virtually giving up that meaſure. They all adopt, in every inveſtigation, the two theorems $f\dot{t}=\dot{v}$, and $f\dot{s}=v\dot{v}$; both of which ſuppoſe an accelerating force f proportional to the velocity v which it produces by its uniform action during the time t, and the theorem $\int f\dot{s}=v^2$ is the 39th 1. Princip. and is the *conſervatio virium vivarum.*

This famous diſpute (the only one in the circle of mathematical ſcience) has led us ſomewhat aſide. But we have little more to remark with reſpect to meaſurable quantity. We cannot ſay what varieties of quantity are ſuſceptible of ſtrict meaſure, or that it is impoſſible to give accurate meaſures of every thing ſuſceptible of augmentation and diminution. We affirm, however, with confidence, that pain, pleaſure, joy, &c. are not made up of their own parts, which can be contemplated ſeparately: but they may chance to be aſſociated by nature with ſomething that is meaſurable; and we may one day be able to aſſign their degrees with as much preciſion as we now aſcertain the degrees of warmth by the expanſion of the fluid in the thermometer. There is one ſenſe in which they may all be

* Micrographia, vis reſtitutiva, &c. in his Poſthumous Works.

be meaſured, viz. numerically, as Newton meaſures denſity, *vis motrix*, &c. We can conceive the pain of each of a dozen men to be the ſame. Then it is evident that the pain of eight of theſe men is to that of the remaining four as two to one; but from ſuch menſuration we do not foreſee any benefit likely to ariſe.

Quantity, in grammar, an affection of a ſyllable, whereby its meaſure, or the time wherein it is pronounced, is aſcertained; or that which determines the ſyllable to be long or ſhort.

Quantity is alſo the object of proſody, and diſtinguiſhes verſe from proſe; and the economy and arrangement of quantities, that is, the diſtribution of long and ſhort ſyllables, makes what we call the *number*. See Poetry, Part III.

The quantities are uſed to be diſtinguiſhed, among grammarians, by the characters ˘, ſhort, as pĕr; and —, long, as rōs. There is alſo a common, variable, or dubious quantity; that is, ſyllables that are one time taken for ſhort ones, and at another time for long ones; as the firſt ſyllable in *Atlas*, *patres*, &c.

QUARANTINE, is a trial which ſhips muſt undergo when ſuſpected of a peſtilential infection. In England it may be ordered by the king, with advice of the privy-council, at ſuch times, and under ſuch regulations, as he judges proper. Ships ordered on quarantine muſt repair to the place appointed, and muſt continue there during the time preſcribed (generally ſix weeks); and muſt have no intercourſe with the ſhore, except for neceſſary proviſions, which are conveyed with every poſſible precaution. When the time is expired, and the goods opened and expoſed to the air as directed, if there be no appearance of infection they are admitted to port.

Ships infected with the peſtilence muſt proceed to St Helen's Pool in the Scilly iſlands, and give notice of their ſituation to the cuſtomhouſe officers, and wait till the king's pleaſure be known.

Perſons giving falſe information to avoid performing quarantine, or refuſing to go to the place appointed, or eſcaping, alſo officers appointed to ſee quarantine performed, deſerting their office, neglecting their duty, or giving a falſe certificate, ſuffer death as felons.

Goods from Turkey, or the Levant, may not be landed without licenſe from the king, or certificate that they have been landed and aired at ſome foreign port. See Plague.

QUARLES (Francis), the ſon of James Quarles clerk to the board of green cloth and purveyor to queen Eliſabeth, was born in 1592. He was educated at Cambridge; became a member of Lincoln's inn; and was for ſome time cup bearer to the Queen of Bohemia, and chronologer to the city of London. It was probably on the ruin of her affairs that he went to Ireland as ſecretary to archbiſhop Uſher; but the troubles in that kingdom forcing him to return, and not finding affairs more at peace in England, ſome diſquiets he met with were thought to have haſtened his death, which happened in 1644. His works both in proſe and verſe are numerous, and were formerly in great eſteem, particularly his Divine Emblems: but the obſolete quaintneſs of his ſtyle has cauſed them to fall into neglect, excepting among particular claſſes of readers. "The memory of Quarles, ſays a late author, has been branded with more than common abuſe, and he ſeems to have been cenſured merely from the want of being read. If his poetry failed to gain him friends and readers, his piety ſhould at leaſt have ſecured him peace and good-will. He too often no doubt, miſtook the enthuſiaſm of devotion for the inſpiration of fancy; to mix the waters of Jordan and Helicon in the ſame cup, was reſerved for the hand of Milton; and for him, and him only, to find the bays of Mount Olivet equally verdant with thoſe of Parnaſſus. Yet, as the effuſions of a real poetical mind, however thwarted by untowardneſs of ſubject, will be ſeldom rendered totally abortive, we find in Quarles original imagery, ſtriking ſentiment, fertility of expreſſion, and happy combinations; together with a compreſſion of ſtyle that merits the obſervation of the writers of verſe. Groſs deficiencies of judgment, and the infelicity of his ſubjects, concurred in ruining him. Perhaps no circumſtance whatever can give a more complete idea of Quarles's degradation than a late edition of his emblems; the following paſſage is extracted from the preface: 'Mr Francis Quarles, the author of the Emblems that go under his name, was a man of the moſt exemplary piety, and had a deep inſight into the myſteries of our holy religion. But, for all that, the book itſelf is written in ſo old a language, that many parts of it are ſcarce intelligible in the preſent age; many of his phraſes are ſo affected, that no perſon, who has any taſte for reading, can peruſe them with the leaſt degree of pleaſure; many of his expreſſions, are harſh, and ſometimes whole lines are included in a parantheſis, by which the mind of the reader is diverted from the principal object. His Latin mottos under each cut can be of no ſervice to an ordinary reader, becauſe he cannot underſtand them. In order, therefore, to accommodate the public with an edition of Quarles's Emblems properly moderniſed, this work was undertaken.' Such an exhibition of Quarles is chaining Columbus to an oar, or making John Duke of Marlborough a train-band corporal."

Headley's ſelect Beauties of Ancient English Poetry.

QUARRIES, a name commonly given to a moſt extraordinary cavern under the city of Paris, the exiſtence of which is known to few even of the inhabitants, and many of thoſe who have heard of it conſider the whole as an idle ſtory. Mr Thomas White, however, member of the Royal Medical Society of Edinburgh, &c. who viſited it in 1784, puts the matter beyond a doubt; having, with many others, obtained leave (which is very cautiouſly granted) to inſpect it, having guides and torches with them. He gives the following account of it in the ſecond volume of the Mancheſter Tranſactions. "At the entrance by the *Obſervatoire Royal*, the path is narrow for a conſiderable way; but ſoon we entered large and ſpacious ſtreets, all marked with names, the ſame as in the city; different advertiſements and bills were found, as we proceeded, paſted on the walls, ſo that it had every appearance of a large town ſwallowed up in the earth.

"The general height of the roof is about 9 or 10 feet; but in ſome parts not leſs than 30 and even 40. In many places there is a liquor continually dropping from it, which congeals immediately, and forms a ſpecies of tranſparent ſtone, but not ſo fine and clear as rock cryſtal. As we continued our peregrination, we thought ourſelves in no ſmall danger from the roof, which we found but indifferently propped in ſome places with wood much decayed. Under the houſes, and many of the ſtreets, however, it ſeemed to be tolerably ſecured by immenſe ſtones ſet in mortar; in other parts, where there are only fields or gardens above, it was totally unſupported for a conſiderable ſpace, the roof being perfectly level, or a plane piece of rock. After traverſing about two miles, we again deſcended about 20 ſteps, and here found ſome workmen in a very cold and damp place, propping up a moſt dangerous part, which they were fearful would give way every moment. The path here is not more than three feet in width, and the roof ſo low, that we were obliged to ſtoop conſiderably.

“ On walking ſome little diſtance farther, we entered into a kind of ſaloon cut out of the rock, and ſaid to be exactly under the *Egliſe de St Jacques*. This was illuminated with great taſte, occaſioned an agreeable ſurpriſe, and made us all ample amends for the danger and difficulty we had juſt before gone through. At one end was a repreſentation in miniature of ſome of the principal forts in the Indies, with the fortifications, drawbridges, &c. Cannons were planted with a couple of ſoldiers to each ready to fire. Centinels were placed in different parts of the garriſon, particularly before the governor's houſe; and a regiment of armed men was drawn up in another place with their general in the front. The whole was made up of a kind of clay which the place affords, was ingeniouſly contrived, and the light that was thrown upon it gave it a very pretty effect.

“ On the other ſide of this hall was a long table ſet out with cold tongues, bread, and butter, and ſome of the beſt Burgundy I ever drank. Now every thing was hilarity and mirth; our fears were entirely diſpelled, and the danger we dreaded the moment before was now no longer thought of. In ſhort, we were all in good ſpirits again, and proceeded on our journey about two miles farther, when our guides judged it prudent for us to aſcend, as we were then got to the ſteps which lead up to the town. We here found ourſelves ſafe at the *Val de Grace*, near to the Engliſh Benedictine convent, without the leaſt accident having happened to any one of the party. We imagined we had walked about two French leagues, and were abſent from the ſurface of the earth betwixt four and five hours.

“ There were formerly ſeveral openings into the quarries, but the two I have mentioned, viz. the *Obſervatory* and the *Val de Grace*, are, I believe, the only ones left; and theſe the inſpectors keep conſtantly locked, and rarely open them, except to ſtrangers particularly introduced, and to workmen who are always employed in ſome part by the king. The police thought it a neceſſary precaution to ſecure all the entrances into this cavern, from its having been formerly inhabited by a famous gang of robbers, who infeſted the country for many miles round the city of Paris.

“ As to the origin of this quarry, I could not, on the ſtricteſt inquiry, learn any thing ſatisfactory; and the only account I know publiſhed is the following contained in the *Tableaux de Paris, nouvelle edition, tom premier, chapitre 5me, page 12me.*

“ For the firſt building of Paris it was neceſſary to get the ſtone in the environs; and the conſumption of it was very conſiderable. As Paris was enlarged, the ſuburbs were inſenſibly built on the ancient quarries, ſo that all that you ſee without is eſſentially wanting in the earth for the foundation of the city: hence proceed the frightful cavities which are at this time found under the houſes in ſeveral quarters. They ſtand upon abyſſes. It would not require a very violent ſhock to throw back the ſtones to the place from whence they have been raiſed with ſo much difficulty. Eight men being ſwallowed up in a gulph 150 feet deep, and ſome other leſs known accidents, excited at length the vigilance of the police and the government, and, in fact, the buildings of ſeveral quarters have been privately propped up; and by this means a ſupport given to theſe obſcure ſubterraneous places which they before wanted.

“ All the ſuburbs of St James's, Harp-ſtreet, and even the ſtreet of Tournon, ſtand upon the ancient quarries; and pillars have been erected to ſupport the weight of the houſes. What a ſubject for reflections, in conſidering this great city formed and ſupported by means abſolutely coutrary! Theſe towers, theſe ſteeples, the arched roofs of theſe temples, are ſo many ſigns to tell the eye that what we now ſee in the air is wanting under our feet.”

QUARRY, a place under ground, out of which are got marble, freeſtone, ſlate, limeſtone, or other matters proper for building. See STRATA.

Some limeſtone quarries in Fife are highly worthy the attention of the curious, on account of an amazing mixture of ſea-bodies found in them. One of this kind was opened about the year 1759, at a farm called *Enderteel*, in the neighbourhood of Kirkaldy, belonging to General St Clair.

The flakes of the ſtone, which are of unequal thickneſs, moſt of them from eight to ten inches, lie horizontally, dipping towards the ſea. Each of theſe flakes, when broken, preſents to our view an amazing collection of petrified ſea bodies, as the bones of fiſhes, ſtalks of ſea-weed, vaſt quantities of ſhells, ſuch as are commonly found on thoſe coaſts, beſides ſeveral others of very uncommon figures. In ſome places the ſhells are ſo numerous, that little elſe is to be ſeen but prodigious cluſters or concretions of them. In the uppermoſt ſtratum the ſhells are ſo entire, that the outer cruſt or plate may be ſcraped off with the finger; and the ſtalks of the ſea-weed have a darkiſh colour, not that gloſſy whiteneſs which they have in the heart of the quarry. The ſmalleſt rays or veins of the ſhells are deeply indented on the ſtone, like the impreſſion of a ſeal upon wax. In ſhort, no ſpot at the bottom of the ocean could exhibit a greater quantity of ſea-bodies than are to be found in this ſolid rock; for we have the ſkeletons of ſeveral fiſhes, the *antennæ* or feelers of lobſters, the roots and ſtalks of ſea-weeds, with the very *capſulæ* which contain the ſeed. The place where all theſe curioſities are found is on an eminence about an Engliſh mile from the ſea; and as the ground is pretty ſteep the whole way, it may be 200 feet higher at leaſt.

There are two or three things to be remarked here. 1. That among all the bodies we have mentioned, there are none but what are ſpecifically heavier than water. This holds ſo conſtantly true, that the ſea-weed, which floats in water when the plant is entire, has been ſtripped of the broad leaves, which make it buoyant, before it has been lodged here. 2. The ſhells have been all empty; for the double ones, as thoſe of the flat kind, are always found ſingle, or with one ſide only. 3. The rock ſeems to have been gradually deſerted by the ſea, and for a long time, waſhed with the tides; for the upper ſurface is all eaten, and hollowed in many places like an honey-comb, juſt as we obſerve in flat rocks expoſed every tide to the acceſs and receſs of the waters. See the article Sea.

Quarry, or *Quarrel*, among glaziers, a pane of glaſs cut in a diamond form.

Quarries are of two kinds, ſquare and long; each of which are of different ſizes, expreſſed by the number of the pieces that make a foot of glaſs, viz. eighths, tenths, eighteenths, and twentieths: but all the ſizes are cut to the ſame angles, the acute angle in the ſquare quarrels being 77° 19′, and 67° 21′ in the long ones.

Quarry, among hunters, is ſometimes uſed for a part of the entrails of the beaſt taken, given by way of reward to the hounds.

Quarry, in falconry, is the game which the hawk is in purſuit of, or has killed.

QUARTAN, a meaſure containing the fourth part of ſome other meaſure.

Quartan, a ſpecies of intermitting fever. See Medicine, n° 153, 158, and 159.

QUARTATION, is an operation by which the quantity of one thing is made equal to a fourth part of the quantity of another thing. Thus when gold allayed with ſilver is to be parted, we are obliged to facilitate the action of the aquafortis, by reducing the quantity of the former of theſe metals to one fourth part of the whole maſs; which is done by ſufficiently increaſing the quantity of the ſilver, if it be neceſſary. This operation is called *quartation*, and is preparatory to the parting; and even many authors extend this name to the operation of parting. See the article Parting.

QUARTER, the fourth part of any thing, the fractional expreſſion for which is $\frac{1}{4}$.

Quarter, in weights, is generally uſed for the fourth part of an hundred weight avoirdupois, or 28 ℔.

Uſed as the name of a dry meaſure, *quarter* is the fourth part of a ton in weight, or eight buſhels.

Quarter, a term in the manege. To work from quarter to quarter, is to ride a horſe three times in upon the firſt of the four lines of a ſquare; then changing your hand, to ride him three times upon the ſecond: and ſo to the third and fourth; always changing hands, and obſerving the ſame order.

Quarters, with reſpect to the parts of a horſe, is uſed in various ſenſes: thus the ſhoulders and fore-legs are called the *fore-quarters*, and the hips and hinder-legs the *hind-quarters*. The *quarters* of a horſe's foot are the ſides of the coffin, comprehending between the toe and the heel: the *inner* quarters are thoſe oppoſite to one another, facing from one foot to the other; and theſe are always weaker than the *outſide* quarters, which lie on the external ſides of the coffin. *Falſe quarters*, are a cleft in the horn of a horſe's hoof, extending from the coronet to the ſhoe. A horſe is ſaid to be *quarter-caſt*, when for any diſorder in the coffin we are obliged to cut one of the quarters of the hoof.

Quarter, in aſtronomy, the fourth part of the moon's period: thus, from the new moon to the quadrature is the firſt quarter; from this to full moon, the ſecond quarter, &c.

Quarter, in heraldry, is applied to the parts or members of the firſt diviſion of a coat that is quartered, or divided into four quarters.

Franc Quarter, in heraldry, is a quarter ſingle or alone; which is to poſſeſs one fourth part of the field. It makes one of the honourable ordinaries of a coat.

Quarter of a ſhip, that part of the ſhip's ſide which lies towards the ſtern; or which is comprehended between the aftmoſt end of the main chains and the ſides of the ſtern, where it is terminated by the quarter-pieces.

Although the lines by which the quarter and bow of a ſhip, with reſpect to her length, are only imaginary, yet experience appears ſufficiently to have aſcertained their limits: ſo that if we were to divide the ſhip's ſides into five equal portions, the names of each ſpace would be readily enough expreſſed. Thus the firſt, from the ſtern, would be the quarter; the ſecond, abaft the midſhips; the third, the midſhips; the fourth, before the midſhips; and the fifth, the bow. Whether theſe diviſions, which in reality are ſomewhat arbitrary, are altogether improper, may be readily diſcovered by referring to the mutual ſituation or approach of two adjacent veſſels. The enemy boarded us on the larboard ſide! Whereabouts? Abaft the midſhips, before the midſhips, &c.

Plate CCCCXXVII. n° 1. repreſents a geometrical elevation of a quarter of a 74 gun ſhip. A the keel, with *a* the falſe keel beneath it. B the ſtern-poſt. DD the quarter-gallery, with its balluſtrades and windows. EE the quarter-pieces, which limit and form the outlines of the ſtern. F the taffarel, or upper pieces of the ſtern. FG the profile of the ſtern, with its galleries. H the gun-ports of the lower-deck; *h* the gun-ports of the upper and quarter-deck. I the after-part of the mizen-channel. K the wing-tranſom. KG the lower counter. LB the ſtation of the deck-tranſom. LQ the after-part of the main-wale. DR the after-part of the channel-wale, parallel to the main-wale. SU the ſheer-rail, parallel to both wales. T *t* the rudder. A *t* F the rake of the ſtern. P *i i* the drift-rails. TU the after-part of the load *water-line*; *k k l* the curve of the ſeveral decks correſponding to thoſe repreſented in the head. See the article Head.

As the marks, by which veſſels of different conſtructions are diſtinguiſhed from each other, are generally more conſpicuous on the ſtern or quarter than any other part, we have repreſented ſome of the quarters, which aſſume the moſt different ſhapes, and form the greateſt contraſt with each other. N° 2. ſhows the ſtern and quarter of a Dutch flight. N° 3. the ſtern and quarter of a cat. N° 4. is the ſtern and quarter of a common galley. N° 5. exhibits the quarter of a firſt-rate galley, otherwiſe called a *galleaſſe*. N° 6. the quarter of a Dutch dogger, or galliot. N° 7. repreſents the ſtern and quarter of a ſloop of war.

The quarters of all other ſhips have a near affinity to thoſe above exhibited. Thus all ſhips of the line, and Eaſt-Indiamen, are formed with a quarter little differing from the principal figure in this plate. Xebecs have quarters nearly reſembling thoſe of galleaſſes, only ſomewhat higher. Hagboats and pinks approach the figure of *cats*, the former being a little broader in the ſtern, and the latter a little narrower; and the ſterns and quarters of cats ſeem to be derived from thoſe of fly-boats. The ſterns of Dutch doggers and galliots are indeed ſingular, and like thoſe of no other modern veſſel: they have nevertheleſs a great reſemblance to the ſhips of the ancient Grecians, as repreſented in medals and other monuments of antiquity.

On the Quarter, may be defined an arch of the horizon, contained between the line prolonged from the ſhip's ſtern and any diſtant object, as land, ſhips, &c. Thus if the ſhip's keel lies on an eaſt and weſt line, the ſtern being weſtward, any diſtant object perceived on the north-weſt or ſouth-weſt, is ſaid to be on the larboard or ſtarboard quarter.

Quarter-Bill, a roll, or liſt, containing the different ſtations, to which all the officers and crew of the ſhip are quartered in the time of battle, and the names of all the perſons appointed to thoſe ſtations. See *Quarters*.

Quarter-Maſter, is an officer, generally a lieutenant, whoſe principal buſineſs is to look after the quarters of the ſoldiers, their clothing, bread, ammunition, firing, &c. Every regiment of foot and artillery has a quarter-maſter, and every troop of horſe one, who are only warrant-officers, except in the Blues.

Quarter-Maſter-General, is a conſiderable officer in the army; and ſhould be a man of great judgment and experience, and well ſkilled in geography. His duty is to mark the marches and encampments of an army: he ſhould know the country perfectly well, with its rivers, plains, marſhes, woods, mountains, defiles, paſſages, &c. even to the ſmalleſt brook. Prior to a march, he receives the order and route from the commanding general, and appoints a place for the quarter-maſters of the army to meet him next morning, with whom he marches to the next camp; where being come, and having viewed the ground, he marks out to the regimental quarter-maſters the ground allowed each regiment for their camp: he chooſes the head-quarters, and appoints the villages for the generals of the army's quarters: he appoints a proper place for the encampment of the train of artillery: he conducts foraging parties, as likewiſe the troops to cover them againſt aſſaults, and has a ſhare in regulating the winter-quarters and cantonments.

Quarter-Netting, a ſort of net-work, extended along the rails on the upper part of a ſhip's quarter. In a ſhip of war theſe are always double, being ſupported by iron cranes, placed at proper diſtances. The interval is ſometimes filled with cork, or old ſails; but chiefly with the hammocks of the ſailors, ſo as to form a parapet to prevent the execution of the enemy's ſmall arms in battle.

Blackſt. Comment. vol. iv. p. 271.

Quarter-Seſſions, a general court held quarterly by the juſtices of peace of each county. This court is appointed by ſtat. 2. Hen. V. c. 4. to be in the firſt week after Michaelmas-day; the firſt week after the Epiphany; the firſt week after the cloſe of Eaſter; and in the week after the tranſlation of Saint Thomas a Becket, or the 7th of July. This court is held before two or more juſtices of the peace, one of whom muſt be of the *quorum*. The juriſdiction of this court by 34 Ed. III. c. 1. extends to the trying and determining of all felonies and treſpaſſes whatſoever, though they ſeldom, if ever, try any greater offence than ſmall felonies within the benefit of clergy, their commiſſion providing, that if any caſe of difficulty ariſes, they ſhall not proceed to judgment, but in the preſence of one of the juſtices of the courts of king's bench or common pleas, or one of the judges of aſſize. And therefore murderers and other capital felons are uſually remitted for a more ſolemn trial to the aſſizes. They cannot alſo try any new-created offence, without expreſs power given them by the ſtatute which creates it. But there are many offences, and particular matters, which by particular ſtatutes belong properly to this juriſdiction, and ought to be proſecuted in this court; as, the ſmaller miſdemeanors againſt the public or commonwealth, not amounting to felony, and eſpecially offences relating to the game, highways, alehouſes, baſtard children, the ſettlement and proviſion for the poor, vagrants, ſervants wages, apprentices, and popiſh recuſants. Some of theſe are proceeded upon by indictment, and others in a ſummary way by motion and order thereupon; which order may, for the moſt part, unleſs guarded againſt by particular ſtatutes, be removed into the court of king's bench, by writ of *certiorari facias*, and be there either quaſhed or confirmed. The records or rolls of the ſeſſions are committed to the cuſtody of a ſpecial officer, denominated the *cuſtos rotulorum*. In moſt corporation towns there are quarter-ſeſſions kept before juſtices of their own, within their reſpective limits, which have exactly the ſame authority as the general quarter-ſeſſions of the county, except in very few inſtances: one of the moſt conſiderable of which is the matter of appeals from orders of removal of the poor, which, though they be from the orders of corporation juſtices, muſt be to the ſeſſions of the county, by 8 and 9 Will. III. c. 30. In both corporations and counties at large, there is ſometimes kept a ſpecial or petty ſeſſion, by a few juſtices, for diſpatching ſmaller buſineſs in the neighbourhood between the times of the general ſeſſions, as for licenſing alehouſes, paſſing the accounts of pariſh-officers, and the like.

Quarter-Staff, a long ſtaff borne by foreſters, park-keepers, &c. as a badge of their office, and occaſionally uſed as a weapon.

QUARTERS, a name given at ſea to the ſeveral ſtations where the officers and crew of a ſhip of war are poſted in action. See *Naval Tactics*.

The number of men appointed to manage the artillery is always in proportion to the nature of the guns, and the number and condition of the ſhip's crew. They are, in general, as follow, when the ſhip is well manned, ſo as to fight both ſides at once occaſionally:

Pounder.		No. of men.	Pounder.		No. of men.
To a 42	-	15	To a 9	-	6
32	-	13	6	-	5
24	-	11	4	-	4
18	-	9	3	-	3
12	-	7			

This number, to which is often added a boy to bring powder to every gun, may be occaſionally reduced, and the guns nevertheleſs well managed. The number of men appointed to the ſmall arms, on board his majeſty's ſhips and ſloops of war, by order of the admiralty, are,

Rate

Rate of the ſhip.	No. of men to the ſmall arms.
1ſt	150
2d	120
3d of 80 guns	100
— of 70 guns	80
4th of 60 guns	70
4th of 50 guns	60
5th	50
6th	40
Sloops of war	30

The lieutenants are uſually ſtationed to command the different batteries, and direct their efforts againſt the enemy. The maſter ſuperintends the movements of the ſhip, and whatever relates to the ſails. The boatſwain, and a ſufficient number of men, is ſtationed to repair the damaged rigging; and the gunner and carpenter, wherever neceſſary, according to their reſpective offices.

The marines are generally quartered on the poop and forecaſtle, or gang-way, under the direction of their officers; although, on ſome occaſions, they aſſiſt at the great guns, particularly in diſtant cannonading.

Quarters, at a ſiege, the encampment upon one of the moſt principal paſſages round a place beſieged, to prevent relief and convoys.

Head Quarters *of an Army*, the place where the commander in chief has his quarters. The quarters of generals of horſe are, if poſſible, in villages behind the right and left wings, and the generals of foot are often in the ſame place: but the commander in chief ſhould be near the centre of the army.

Quarters *of Refreſhment*, the place or places where troops that have been much haraſſed are put to recover themſelves during ſome part of the campaign.

Intrenched Quarters, a place fortified with a ditch and parapet to ſecure a body of troops.

Winter Quarters, ſometimes means the ſpace of time included between leaving the camp and taking the field; but more properly the places where the troops are quartered during the winter.

The firſt buſineſs, after the army is in winter-quarters, is to form the chain of troops to cover the quarters well: which is done either behind a river, under cover of a range of ſtrong poſts, or under the protection of fortified towns. Huſſars are very uſeful on this ſervice.

It ſhould be obſerved, as an invariable maxim, in winter-quarters, that your regiments be diſpoſed in brigades, to be always under the eye of a general officer; and, if poſſible, let the regiments be ſo diſtributed, as to be each under the command of its own chief.

QUARTERING, in heraldry, is dividing a coat into four or more quarters, or quarterings, by parting, couping, &c. that is, by perpendicular and horizontal lines, &c.

QUARTO-decimans, an ancient ſect in the Chriſtian church, who taught that Eaſter ſhould always be celebrated according to the cuſtom of the Jews, on the fourteenth day of the moon in the month of March, whenſoever that day fell out. And hence they derived their name *quarto decimani*, q. d. Fourteenthers. The Aſiatics were mightily attached to this opinion, pretending that it was built on the authority of St John, who was their apoſtle; and pope Victor could never bring them to obedience in this article, though he was upon the point of excommunicating them: but it is more probable he contented himſelf with menaces. See Easter.

QUARTZ, a genus of ſiliceous earths very common in Europe. According to Kirwan, the quartz are in general the pureſt of the ſiliceous kind, though moſt of them contain a ſlight mixture of other earths: the moſt obvious diſtinction among them ariſes from their opacity or tranſparency. Cronſtedt gives the following characteriſtics of it: 1. It is generally cracked throughout, even in the rock itſelf, whereby, as well as by its own nature, it breaks into irregular and ſharp fragments. 2. It cannot be eaſily made red hot, without cracking ſtill more. 3. It never decays in the air. 4. Melted with fixed alkali in a due proportion, it gives a more ſolid and fixed glaſs than any of the other ſiliceous ſtones. 5. When there has been no interruption in its natural accretion, it always cryſtallizes into hexagonal priſms pointed at both ends. 6. It is met with in clefts, fiſſures, and ſmall veins in rocks; it ſeldom forms large veins, and ſtill more rarely whole mountains, without a mixture of heterogeneous ſubſtances. It is found,

1. Pure, of ſeveral varieties, as, (1.) Solid, or having no viſible particles, and called *fat quartz*. This is either tranſparent, white, blue, or violet-coloured. The firſt kind is met with in the copper-mines in the northern part of Norway and Siberia, and has no regular form, but is as clear as the fineſt cryſtallized quartz, or rock cryſtal. (2.) *Grained quartz*, of a white or pale green colour, found in various places in Sweden. (3.) The *ſparry quartz*, which is the ſcarceſt of the whole, and ought not to be confounded with the white felt-ſpar, becauſe it is of a ſmoother appearance, and breaks into larger and more irregular planes. It is found of a whitiſh yellow, from the gold mines in Hungary; or white, from the iſland of Uto. Brunnich tells us, that the Hungarian gold and ſilver mines near Hodentch, which have veins frequently ſome fathoms wide, afford a kind of lamellated and porous quartz. It is met with of white, yellow, and blue colours, and it is ſometimes finely cryſtallized in pyramidical figures.

2. *Cryſtallized quartz*, or *rock cryſtal*. See Crystal.

3. *Impure quartz*. Of this there are two kinds, (1.) Mixed with iron, in form of a black calx. It is black, gloſſy, and contains a great quantity of iron. It is found in Sweden. (2.) Mixed with copper, and of a red colour, found in the ſame country.

Cronſtedt obſerves, that quartz in general, and eſpecially its cryſtals, are very commonly ſuppoſed, when yet in their ſoft and diſſolved ſtate, to have included within them ſome vegetables, for inſtance graſs and moſs. "This (ſays he) I cannot abſolutely deny; but it deſerves carefully to be examined if that which is ſhown as a graſs be not an aſbeſtos, or a ſtriated cockle; and the moſs only branched varieties filled with earth, which, by their being ramoſe, bear a vegetable appearance. It is very common in agates, and makes them of leſs value than they otherwiſe would be. This is moſt generally the caſe with thoſe ſtones which are ſhown as including vegetables; and, for my own part, I have never been ſo fortunate as to meet with any others."

M. Magellan remarks, that quartz is one of the principal kinds of ſtone which contain metals. Some of the Hungarian veins conſiſt entirely of it, and the gold is ſo minutely diſperſed, that it cannot be diſcerned by the beſt microſcopes before it is ſeparated by pounding and waſhing. The width of the veins, ſome of which are half a fathom, and ſome ſtill more, repay the trouble and expences, which the ſmall quantity of gold would not otherwiſe counterbalance. Nature has not any where produced mountains of pure quartz; for though ſome rocks in Sweden are ranked among the quartzes, they are undoubtedly mixed with heterogeneous matters. Near Lauterberg upon the Hartz are veins of this ſtone from one to three fathoms wide, conſiſting of a looſe ſand, in which they find the copper ore in neſts. In the Daniſh iſle of Anhalt we meet with triangular quartz pebbles. There are likewiſe cryſtals of quartz having water incloſed in them; ſome fine pieces of this kind are to be met with in the Imperial cabinet at Vienna, &c.

Rock cryſtals are generally found upon or among quartz, and are to be met with in all parts of the world. The greateſt number are furniſhed to the European countries from Mount Saint Gothard in Switzerland.—Here large pieces, weighing from 5 to 800 pounds, were found at Grimſelberg; one of 1200 pounds was found ſome years ago at Fiſbach in the Wallais; and a piece ſix feet long, four broad, and equally thick, was found in the iſland of Madagaſcar, a place where theſe natural productions are of the moſt extraordinary ſize and perfection.

When great quantities of quartz are continually agitated by the ſea or river water, they are ſometimes reduced to ſuch very minute parts as to be eaſily carried away, ſuſpended in the water; and there are ſands of ſo minute a ſize as to meaſure leſs than the two or three hundreth part of an inch. Theſe are called *quick-ſands*. Immenſe tracts of land conſiſt only of looſe ſands, particularly along the ſea-ſhore in many parts of Europe. Some ſuppoſe that ſea-water has the power of producing this ſand out of its own ſubſtance; and their ſurfaces, in general, are ſo poliſhed, as to ſhow that they could not be reduced in ſize by rubbing againſt each other; but we know not as yet that ſuch a production has ever been demonſtrated. When ſand is about as big as peas, it is called gravel; and when it is free from ſaline and heterogeneous particles, it is employed in making mortar, and other economical purpoſes. That which is very pure ſerves for making flint-glaſs, with red calces of lead, and the proper alkaline flux; but when mixed with ferruginous black ſand, the glaſs aſſumes a greeniſh black colour. "This (ſays M. Magellan) I have ſeen among the various ſpecimens of glaſs made by Mr E. Delaval, F. R. S. who produced a very fine tranſparent and colourleſs glaſs out of the ſame ſand with which he had made ſome of that black glaſs, and this only by ſeparating from it all the ferruginous mixture."

QUASHING, in law, the overthrowing and annulling a thing.

QUASI-CONTRACT, in the civil law, an act without the ſtrict form of a contract, but yet having the force thereof. In a contract there muſt be the mutual conſent of both parties, but in a *quaſi-contract* one party may be bound or obligated to the other, without having given his conſent to the act whereby he is obliged. For example: I have done your buſineſs, in your abſence, without your procuration, and it has ſucceeded to your advantage. I have then an action againſt you for the recovery of what I have diſburſed, and you an action againſt me to make me give an account of my adminiſtration, which amounts to a *quaſi-contract*.

Quasi-Crime, or *Quaſi-delict*, in the civil law, the action of a perſon who does damage, or evil, involuntarily. The reparation of *quaſi-crimes* conſiſts in making good the damages, with intereſt.

QUASS, a fermented liquor drunk in Ruſſia. See PEASANT.

QUASSIA, in botany: A genus of the monogynia order, belonging to the decandria claſs of plants; and in the natural method ranking under the 14th order, *Gruinales*. The calyx is pentaphyllous; there are five petals; the nectarium is pentaphyllous; there are from two to five ſeed-caſes ſtanding aſunder, and monoſpermous. There are three ſpecies, the *amara*, *ſimaruba*, and *excelſa* or *polygama*.

Woodville's Medical Botany, Vol. ii. p. 215.

The quaſſia amara grows to the height of ſeveral feet, and ſends off many ſtrong branches. The wood is of a white colour and light; the bark is thin and grey: the leaves are placed alternately on the branches, and conſiſt of two pair of oppoſite pinnæ, with an odd one at the end: all the leafets are of an elliptical ſhape, entire, veined ſmooth, pointed, ſeſſile, on the upper pagina of a deep green colour, on the under paler: the common footſtalk is articulated, and winged, or edged, on each ſide with a leafy membrane, which gradually expands towards the baſe of the pinnæ: the flowers are all hermophradite, of a bright red colour, and terminate the branches in long ſpikes: the bracteæ or floral leaves are lance-ſhaped or linear, coloured, and placed alternately upon the peduncles: the calyx is ſmall, perſiſtent, and five-toothed: the corolla conſiſts of five lance-ſhaped equal petals, at the baſe of which is placed the nectary, or five roundiſh, coloured, ſcales: the filaments are ten, ſlender, ſomewhat longer than the corolla, and crowned with ſimple antheræ, placed tranſverſely: the receptacle is fleſhy and orbicular: the germen is ovate, divided into five parts, and ſupports a ſlender ſtyle, longer than the filaments, and terminated by a tapering ſtigma: the capſules are five, two-celled, and contain globular ſeeds. It is a native of South America, particularly of Surinam, and alſo of ſome of the Weſt Indian iſlands. The root, bark, and wood, of this tree have all places in the materia medica. The wood is moſt generally uſed, and is ſaid to be a tonic, ſtomachic, antiſeptic, and febrifuge.

Dr Wright's Paper, Edin. Tranſ. vol. ii.

The quaſſia ſimaruba is common in all the woodlands in Jamaica. It grows to a great height and conſiderable thickneſs. The trunks of the old trees are black and a little furrowed. Thoſe of the young trees are ſmooth and gray, with here and there a broad yellow ſpot. The inſide bark of the trunk and branches is white, fibrous, and tough. It taſtes ſlightly bitter. On cutting or ſtripping off this bark, no milky juice iſſues, as has been mentioned by various authors. The wood is hard, and uſeful for buildings. It ſplits freely, and makes excellent ſtaves for ſugar hogſheads. It has no ſenſible bitter taſte. The branches are alternate and ſpreading. The leaves are numerous and alternate. On the upper ſide, they are ſmooth, ſhining, and of a deep green colour: on the under ſide they are white. The flowers appear about the beginning of April. They are of a yellow colour, and placed on ſpikes beautifully branched.

The fruit is of that kind called a *drupa*, and is ripe towards the end of May. It is of an oval ſhape, is black, ſmooth, and ſhining. The pulp is fleſhy and ſoft; the taſte a nauſeous ſweet. The nut is flattened, and on one ſide winged. The kernel is ſmall, flat; and taſtes ſweet. The natural number of theſe drupæ is five on each common receptacle; but, for the moſt part, there are only two or three; the reſt abort by various accidents. The roots are thick, and run ſuperficially under the ſurface of the ground to a conſiderable diſtance. The bark is rough, ſcaly, and warted. The inſide when freſh is a full yellow, but when dry paler. It has but little ſmell. The taſte is bitter, but not very diſagreeable. This is the true cortex ſimarubæ of the ſhops. This tree is known in Jamaica by the names of *mountain damſon, bitter damſon* and *ſtave-wood*. The ſhops are ſupplied with this bark from Guiana; but now we may have it from our own iſlands at a moderate expence. On examining the fructification, Dr Wright found this tree to be a ſpecies of quaſſia. Under that name he ſent it to Europe, and Linnæus adopted it into his ſyſtem. There are male flowers on one tree and female flowers on another; and this is invariably the caſe in Jamaica.

Moſt authors who have written on the ſimaruba agree, that in fluxes it reſtores the loſt tone of the inteſtines, allays their ſpaſmodic motions, promotes the ſecretions by urine and perſpiration, removes that lowneſs of ſpirits attendng dyſenteries, and diſpoſes the patient to ſleep; the gripes and teneſmus are taken off, and the ſtools are changed to their natural colour and conſiſtence. In a moderate doſe, it occaſions no diſturbance or uneaſineſs; but in a large doze it produces ſickneſs at ſtomach and vomiting. Negroes are leſs affected by it than white people. Dr Cullen, however, ſays, "We can perceive nothing in this bark but that of a ſimple bitter; the virtues aſcribed to it in dyſentery have not been confirmed by my experience, or that of the practitioners in this country; and, leaving what others are ſaid to have experienced to be further examined and conſidered by practitioners, I can only at preſent ſay, that my account of the effect of bitters will perhaps explain the virtues aſcribed to ſimaruba. In dyſentery I have found an infuſion of chamomile flowers a more uſeful remedy." The quaſſia excelſa or polygama was named by Sir Joſeph Banks, Dr Solander, and Dr Wright, *pricrania amara* (ſee Pricrania Amara.) It is ranked, however, by Mr John Lindſay, in a paper in the third volume of the Edinburgh Tranſactions, under *quaſſia*, who gives the following deſcription of it. "It is very common in the woodlands of Jamaica, is beautiful, tall, and ſtately, ſome of them being 100 feet long and ten feet in circumference eight feet above the ground. The trunk is ſtraight, ſmooth, and tapering, ſending off its branches towards the top. The outſide bark is pretty ſmooth, of a light grey or aſh colour, from various lichens. The bark of the roots is of a yellow caſt, ſomewhat like the cortex ſimaruba. The inner bark is tough, and compoſed of fine flaxy fibres. The wood is of a yellow colour, tough, but not very hard. It takes a good poliſh, and is uſed as flooring. The leaves are ſub-alternate; the ſmall leaves are in pairs, from five to eight, ſtanding oppoſite to each other on ſhort footſtalks, and ending with an odd one. They are of an oblong oval ſhape, and pointed; the ribs reddiſh, and the young leaves are covered with a fine browniſh down. The flowers come out in bunches or cluſters from the lower part of the laſt ſhoot before the leaves, and ſtand on round footſtalks. The flowers are ſmall, of a yellowiſh green colour, with a very ſmall calyx. The male or barren tree has flowers nearly ſimilar to the hermaphrodite, but in it there are only the rudiments of a ſtyle.

Materia Medica. vol. ii. p. 75.

"The fruit is a ſmooth black drupa, round-ſhaped, and of the ſize of a pea. There is but little pulp, and the nut covers a round kernel. Theſe drupæ are generally three, ſometimes two, and often only one, attached ſidewiſe to a roundiſh fleſhy receptacle. It flowers in October and November, and its fruit is ripe in December and January. Except the pulp of the fruit, every other part of this tree has an intenſely bitter taſte. In taſte and virtues it is nearly equal to the quaſſia of Surinam and I am credibly informed is ſold in London for the quaſſia amara; and it may be ſafely uſed in all caſes where that drug has been thought proper, whether as an antiſeptic, or in caſes of weakneſs in the ſtomach and bowels. It may either be given alone, or joined with the Jeſuit's bark. The happieſt effects reſult from the uſe of this medicine in obſtinate remitting fevers from marſh miaſmata, in agues which had reſiſted the uſe of Jeſuit's bark and in dyſenteries of long ſtanding. It is in daily practice in dropſies from debility, either in ſimple infuſions or tincture by itſelf, or joined with aromatics and chalybeates. Dr Drummond, an eminent phyſician in Jamaica, preſcribes it with great ſucceſs in the above caſes as well as in amenorrhæa, chloroſis, dyſpepſia, and in that ſpecies of pica called *dirteating*, ſo fatal to a number of negroes.

"The bark of the quaſſia polygama, but eſpecially the wood, is intenſely bitter. They may both be uſed in various forms. In certain caſes of dropſy, aromatics and preparations are joined to it alſo in amenorrhæa and chloroſis; and in worm fevers, the cabbage-bark, or other vegetable anthelmintics."

QUATUORVIR, in antiquity, formerly written IIII. Vir, a Roman magiſtrate, who has three colleagues joined with him in the ſame adminiſtration, and had the care of conducting and ſettling the colonies ſent into the provinces. There were alſo quatuorviri appointed to inſpect and take care of repairs, &c.

QUAVER, in muſic, a meaſure of time equal to half a crotchet, or an eighth part of a ſemibreve.

QUAY. See Key.

QUEBEC, a handſome and large town of America, and capital of Canada. The firſt place taken notice of upon landing here is a ſquare of an irregular figure, with well-built houſes on each ſide; on the back of which is a rock; on the left it is bounded by a ſmall church; and on the right are two rows of houſes, parallel to each other. There is another between the church and the harbour; as alſo another long row on the ſide of the bay. This may be looked upon as a kind of ſuburb; and between this and the great ſtreet is a very ſteep aſcent, in which they have made ſteps for the foot-paſſengers to go up. This may be called the *Upper Town*, wherein is the biſhop's palace; and between two large ſquares is a fort where the governor lodges. The Recolets have handſome houſes over-againſt it, and on the right is the cathedral church: over-againſt this is the Jeſuits college, and between them are well-built houſes; from the fort runs two ſtreets, which are croſſed by a third, and between theſe is a church and a convent. In the ſecond ſquare are two deſcents to the river of St Charles. The Hotel Dieu is in the midway; and from thence are ſmall houſes, which reach to the houſe of the intendant. On the other ſide of the Jeſuits college, where the church ſtands, is a pretty long ſtreet in which is a nunnery. Almoſt all the houſes are built of ſtone, and there are about 7000 inhabitants; the fort is a handſome building, but not quite finiſhed. Quebec is not regularly fortified: but it cannot be eaſily taken; for the harbour is flanked with two baſtions, which at high tides are almoſt level with the water. A little above one of the baſtions is a demi-baſtion, partly taken out of the rock; and above it, on the ſide of the gallery of the fort is a battery, of 25 pieces of cannon: ſtill above this is a ſquare fort called the *citadel;* and the ways from one fortification to another are difficult to paſs. To the left of the harbour, on the ſide of the road, there are large batteries of cannon, and ſome mortars; beſides theſe, there are ſeveral other fortifications not very eaſy to be deſcribed. In 1711 the Britiſh fitted out a fleet with a deſign to conquer Canada, which failed on account of the raſhneſs of the admiral; who, contrary to the advice of his pilot, went too near the Seven iſles, and ſo loſt his largeſt ſhips, and 3000 of his beſt ſoldiers. It is about 300 miles north-weſt of Boſton in New-England. On October 18. 1759, it was taken by the Britiſh under the command of General Wolfe, who loſt his life in the battle, after he had the ſatisfaction to know that his troops were victorious. Admiral Saunders commanded a ſquadron of men of war, and did immenſe ſervice in reducing this place; there being not a man in the navy but what was active on this occaſion, not excepting the ſailors belonging to the tranſport veſſels. After this valuable acquiſition, all Canada came under the juriſdiction of the crown of Great Baitain. W. Long. 69. 48. N. Lat. 46. 55.

QUEDA, a kingdom of Aſia, in the peninſula beyond the Ganges, and near the ſtrait of Malacca. The king is tributary to Siam. The principal town is of the ſame name, and ſaid to contain about 8000 inhabitants; and is ſubject to the Dutch. It has a harbour, and is 300 miles north of Malacca. E. Long. 100. 5. N. Lat. 7. 5.

QUEDLINGBURG, a town of Germany, in the circle of Upper Saxony, and on the confines of the duchy of Brunſwick. Here is a famous abbey, whoſe abbeſs is a princeſs of the empire, and who ſends deputies to the diets. Her contingent is one horſeman and ten footmen. The inhabitants of the town live by brewing, huſbandry, and feeding of cattle. It is 10 miles ſouth-eaſt of Halberſtadt, and 32 weſt of Bernberg. E. Long. 11. 34. N. Lat. 52. 1.

QUEEN, a woman who holds a crown ſingly.

The title of *queen* is alſo given by way of courteſy to her that is married to a king, who is called by way of diſtinction *queen-conſort;* the former being termed *queen-regent*. The widow of a king is alſo called *queen*, but with the addition of *dowager*. See *Royal-Family*.

Queen Charlotte's Sound, is ſituated at the northern extremity of the ſouthern iſland of New Zealand, near Cook's Strait, lying in 41. 6. of ſouth latitude, and 174. 19. of eaſt longitude. The climate of this ſound is much more mild than at Duſky Bay; and though there is not ſuch plenty of wild fowl and fiſh, the defect is ſufficiently compenſated by abundance of excellent vegetables. The hills about the ſound conſiſt moſtly of an argillaceous ſtone of a greeniſh grey, or bluiſh or yellowiſh brown colour. A green talkous or nephritic (by the jewellers called *jadde*) is likewiſe very common, together with hornſtone, ſhingle, ſeveral ſorts of flinty ſtones and pebbles, ſome looſe pieces of baſaltes, ſtrata of a compact mica or glimmer, with particles of quartz. Hence, Mr Forreſter thinks, there is reaſon to believe that this part of New Zealand contains iron-ore, and perhaps ſeveral other metallic ſubſtances. The country is not ſo ſteep as at Duſky Bay, and the hills near the ſea are generally inferior in height, but covered with foreſts equally intricate and impenetrable. Captain Cook ſowed the ſeeds of many vegetables in this place, that have uſeful and nutritive roots. He ſowed alſo corn of ſeveral ſorts, beans, kidney-beans, and peaſe. The dogs here are of the long-haired ſort, with pricked ears, and reſemble the common ſhepherd's cur, but they are very ſtupid animals. They are fed with fiſh, and even dogs fleſh, and perhaps human fleſh, which the natives alſo eat. Captains Cook and Furneaux left on theſe iſlands a boar and two ſows, with a pair of goats, male and female, with ſome geeſe, in order to benefit the natives and future generations of navigators. They left likewiſe among them a number of braſs medals gilt, on one ſide of which was the head of his preſent majeſty, with the inſcription George III. King of Great Britian, France, and Ireland, &c. On the reverſe, a repreſentation of two men of war, with the names Reſolution and Adventure over them; and the exergue, ſailed from England March MDCCLXXII.

Queen-Gold, is a royal duty or revenue belonging to every queen of England during her marriage to the king, payable by perſons in the kingdom and Ireland, on divers grants of the king by way of fine or oblation, &c. being one full tenth part above the entire fines, on pardons, contracts, or agreements, which becomes a real debt to the queen, by the name of *aurum regina* upon the party's bare agreement with the king for his fine, and recording the ſame.

Queen's-County, a diviſion of the province of Leinſter in Ireland; ſo called from the popiſh Queen Mary, in whoſe reign it was firſt made a county by the earl of Suſſex, then lord-deputy. It is bounded on the ſouth by Kilkenny and Catherlogh; by King's county on the north and weſt; part of Kildare and Catherlogh on the eaſt; and part of Tipperary on the weſt. Its greateſt length from north to ſouth is 35 miles, and its breadth near as much; but it is unequal both ways. This county was anciently full of bogs and woods, though now pretty well incloſed, cultivated, and inhabited. The baronies contained in it are ſeven; and it ſends eight members to parliament.

Queen-Bee. See *Bee*, n° 3. &c.

QUEENBOROUGH, a town of the iſle of Sheppey in Kent, which ſends two members to parliament, though conſiſting only of about 100 low brick houſes, and ſcarce 350 inhabitants. The chief employment of the people here is oyſter drudging; oyſters being very plentiful, and of a fine flavour. E. Long. 0. 50. N. Lat. 51. 25.

QUEENS-FERRY, a town of Scotland, in the ſhire of Lothian, ſeated on the ſouth ſide of the river Forth, 9 miles weſt of Edinburgh.

Groſier's General Deſcription of China.

QUEI-LING-FOU, the capital of the province of Quangſi in China, has its name from a flower called *quei*, which grows on a tree reſembling a laurel; it exhales ſo ſweet and agreeable an odour, that the whole country around is perfumed with it. It is ſituated on the banks of a river, which throws itſelf into the Taho; but it flows with ſuch rapidity, and amidſt ſo narrow valleys, that it is neither navigable nor of any utility to commerce. This city is large, and the whole of it is built almoſt after the model of our antient fortreſſes; but it is much inferior to the greater part of the capitals of the other provinces. A great number of birds are found in the territories belonging to it, the colours of which are ſo bright and variegated, that the artiſts of this country, in order to add to the luſtre of their ſilks, interweave with them ſome of their feathers, which have a ſplendor and beauty that cannot be imitated. Quei-ling has under its juriſdiction two cities of the ſecond claſs and ſeven of the third.

QUEI, in natural hiſtory, is a name given by the Chineſe to a peculiar earth found in many parts of the eaſt. It is of the nature of an indurated clay, and in ſome degree approaches to the talcs, as our ſteatites and the galactites do. It is very white and abſterſive, uſed by the women of China to take off ſpots from the ſkin, and render it ſoft and ſmooth, as the Italian ladies uſe talc of Venice. They ſometimes uſe the fine powder of this ſtone dry, rubbing it on the hands and face after waſhing; ſometimes they mix it in pomatum.

QUERCI, a province of Guienne in France; bounded on the north by Limoſin, on the eaſt by Rouergue and Auvergne, on the ſouth by Upper Languedoc, and on the weſt by Agenois and Perigord. It is divided into Upper and Lower; and is fertile in corn, wine, and fruits. Cahors in the capital town.

QUERCUS, the OAK-TREE: A genus of the polyandria order, belonging to the monoecia claſs of plants; and in the natural method ranking under the 50th order, *Amentaceæ*. The calyx is nearly quinquefid; there is no corolla; the ſtamina are from five to ten in number. The female calyx is monophyllous, very entire, and ſcabrous. There is no corolla; the ſtyles are from two to five; and there is an ovate ſeed. See OAK.

Species. 1. The robur, or common Engliſh oak, grows from about 60 or 70 to 100 feet high, with a prodigious large trunk, and monſtrous ſpreading head; oblong leaves, broadeſt towards the top, the edges acutely ſinuated, having the angles obtuſe. There is a variety, having the leaves finely ſtriped with white. This ſpecies grows in great abundance all over England, in woods, foreſts, and hedge-rows; is naturally of an amazing large growth; there being accounts of ſome above 100 feet ſtature, with wonderful large trunks and ſpreading heads; and is ſuppoſed to continue its growth many centuries.

2. The prinus, or cheſnut-leaved American oak, grows 50 or 60 feet high; having large oblong-oval ſmooth leaves pointed both ways, the edges ſinuated-ſerrated, with the ſinuſes uniformly round.

3. The phellos, or willow-leaved American oak, grows 40 or 50 feet high, having long narrow ſmooth entire leaves, like thoſe of the willow. There is a variety called the *dwarf willow-leaved oak*.

4. The alba, or white Virginian oak, grows 30 or 40 feet high, having a whitiſh bark, with long obliquely-pinnatifid light-green leaves, the ſinuſes and angles obtuſe.

5. The nigra, or black Virginian oak, grows 30 or 40 feet high, having a dark-coloured bark, large wedge-ſhaped ſlightly-trilobated leaves.

6. The rubra, or red Virginian oak, grows about 60 feet high, having a dark-greyiſh bark, long obtuſely-ſinuated leaves, with the ſinuſes terminated by briſtly points, and have ſometimes red ſpotted veins, but generally dyeing in autumn to a reddiſh colour, remaining on the trees late in the ſeaſon.

7. The eſculus of Pliny, or cut-leaved Italian oak, grows about 30 feet high, having a purpliſh bark, oblong deeply-ſinuated ſmooth leaves, and long ſlender cloſe-ſitting acorns in very large cups.

8. Ægilops, or large prickly-cupped Spaniſh oak, grows 70 or 80 feet high or more, with a very large trunk, and widely-ſpreading head, having a whitiſh bark, large oblong-oval deeply-ſerrated ſmooth leaves, the ſerratures bowed backward, and large acorns placed in ſingularly large prickly cups. This is a noble ſpecies, almoſt equal in growth to the common Engliſh oak.

9. Cerris, or ſmaller prickly-cupped Spaniſh oak, grows 30 or 40 feet high, and has oblong lyre-ſhaped pinnatifid tranſverſely-jagged leaves, downy underneath, and ſmall acorns placed in prickly cups.

10. The ilex, or common evergreen oak, grows 40 or 50 feet high, having a ſmooth bark, oval and oblong undivided ſerrated petiolated leaves, downy and whitiſh underneath. The varieties are, broad-leaved, narrow-leaved, and ſometimes both ſorts and other different ſhaped leaves on the ſame tree, alſo ſometimes with ſawed and prickly leaves.

11. The gramuntia or Montpelier holly-leaved evergreen oak, grows 40 or 50 feet high; and has oblong-oval, cloſe-ſitting ſinuated ſpinous leaves, downy underneath, bearing a reſemblance to the leaves of holly.

12. The ſuber, or cork-tree, grows 30 or 40 feet high, having a thick, rough, fungous, cleft bark, and oblong-oval undivided ſerrated leaves, downy underneath. This ſpecies furniſhes that uſeful material cork; it being the bark of the tree, which becoming of a thick fungous nature, under which, at the ſame time, is formed a new bark, and the old being detached for uſe, the tree ſtill lives, and the ſucceeding young bark becomes alſo of the ſame thick ſpongy nature in ſix or ſeven years, fit for barking, having likewiſe another freſh bark forming under it, becoming cork like the others in the like period of time; and in this manner theſe trees wonderfully furniſh the cork for our uſe, and of which is made the corks for bottles, bungs for barrels, and numerous other uſeful articles. The tree grows in great plenty in Spain and Portugal, and from theſe countries we receive the cork. The Spaniards

burn it, to make that kind of light black we call Spaniſh black, uſed by painters. Cups made of cork are ſaid to be good for hectical perſons to drink out of. The Egyptians made coffins of cork; which being lined with a reſinous compoſition, preſerved dead bodies uncorrupted. The Spaniards line ſtone-walls with it, which not only renders them very warm, but corrects the moiſture of the air.

13. The coccifera, ſcarlet, or kermes oak, grows but 14 or 15 feet high, branching all the way, and of buſhy growth; with large oval, undivided, indented, ſpinous leaves; and producing ſmall glandular excreſcences, called *kermes* or *ſcarlet grain*, uſed by the dyers. The ſmall ſcarlet glands found in this tree, is the effect of certain inſects depoſiting their eggs betwixt the bark of the branches and leaves, cauſing an extravaſation of the ſap, and forming the excreſcence or ſubſtance in queſtion, which being dried is the kermes or ſcarlet paſtel.

14. The Molucca, Moluccan oak, commonly called *American live oak*, grows about 40 feet high, having oval, ſpear-ſhaped, ſmooth, entire leaves, and ſmall oblong eatable acorns.

All the above 14 ſpecies of quercus produce flowers annually in the ſpring, about April or May, of a yellowiſh colour, but make no ornamental appearance, and are males and females ſeparated in the ſame tree; the males being in looſe amentums, and the females ſitting cloſe to the buds in thick leathery hemiſpherical calyxes, ſucceeded by the fruit or acorns, which are oval nuts fixed by their baſe into rough permanent cups, and moſtly ſit quite cloſe, and ſome on ſhort footſtalks, ripening in autumn; which in the common Engliſh oak is in great abundance, and often in tolerable plenty on ſome of the other ſorts: thoſe of all the kinds ſerve for propagating their reſpective ſpecies; they are alſo excellent food for ſwine and deer, the common oak in particular.

Uſes, &c. Oak-trees, of all the above ſorts may be employed in gardening to diverſify large ornamental plantations in out-grounds, and in forming clumps in ſpacious lawns, parks, and other extenſive opens; the evergreen kinds in particular have great merit for all ornamental purpoſes in gardens. But all the larger growing kinds, both deciduous, and evergreens, demand eſteem principally as firſt-rate foreſt-trees for their timber. The Engliſh oak, however, claims precedence as a timber-tree, for its prodigious height and bulk, and ſuperior worth of its wood. Every poſſeſſor of conſiderable eſtates ought therefore to be particularly aſſiduous in raiſing woods of them, which is effected by ſowing the acorns either in a nurſery and the plants tranſplanted where they are to remain, or ſowed at once in the places where they are always to ſtand. All the ſorts will proſper in any middling ſoil and open ſituation, though in a loamy ſoil they are generally more proſperous: however, there are but few ſoils in which oaks will not grow; they will even thrive tolerably in gravelly, ſandy, and clayey land, as may be obſerved in many parts of this country of the common oak.

The oak is of the utmoſt importance to Britain, and its cultivation deſerves the utmoſt attention. Much, therefore, to the honour of the members of the *London Society for encourging Arts, Manufactures, and Commerce,* they have excited particular attention to it; and many excellent obſervations, drawn from practice, will be found in their Tranſactions.

The propagation of the ſtriped-leaved varieties of the common oak, and any particular variety of the other ſpecies, muſt be effected by grafting, as they will not continue the ſame from ſeed: the grafting may be performed upon any kind of oakling-ſtocks raiſed from the acorns, and train them for ſtandards like the others.

The oak is remarkable for its ſlowneſs of growth, bulk, and longevity. It has been remarked that the trunk has attained to the ſize only of 14 inches in diameter, and of ſome to 20, in the ſpace of fourſcore years. As to bulk, we have an account of an oak belonging to Lord Powis, growing in Broomfield wood, near Ludlow in Shropſhire, in the year 1764, the trunk of which meaſured 68 feet in girth, 24 in length, and which, reckoning 90 feet for the large branches, contained in the whole 1455 feet of timber, round meaſure, or 29 loads and five feet, at 50 feet to a load.

The Greendale oak, &c. we have already mentioned (ſee Oak). In the opinion of many, the Cowthorp oak near Wetherby in Yorkſhire is the father of the foreſt. Dr Hunter, in his edition of Evelyn, has given an engraving of it. Within three feet of the ſurface he ſays it meaſures 16 yards, and cloſe to the ground 62. In 1776, though in a ruinous condition, it was 85 feet high, and its principal limb extended 16 yards from the bole. The foliage was very thin. If this meaſurement were taken as the dimenſion of the *real ſtem*, the ſize of this tree would be enormous; but like moſt very large trees, its ſtem is ſhort, ſpreading wide at the baſe, roots riſing above the ground like buttreſſes to the trunk, which is ſimilar not to a cylinder but to the fruſtum of a cone. Mr Marſham ſays, "I found it in 1768, at four feet, 40 feet 6 inches; at five feet, 36 feet 6 inches; and at ſix feet, 32 feet 1 inch." In the principal dimenſions then, *the ſize of the ſtem*, it is exceeded by the Bentley oak; of which the ſame writer gives the following account: "In 1759 the oak in Holt-Foreſt, near Bentley, was at 7 feet 34 feet. There is a large excreſcence at 5 and 6 feet that would render the meaſure unfair. In 1778, this tree was increaſed half an inch in 19 years. It does not appear to be hollow, but by the trifling increaſe I conclude it not ſound." Theſe dimenſions however, are exceeded by thoſe of the Boddington oak. It grows in a piece of rich graſs land, called the *Old Orchard Ground*, belonging to Boddington Manor-Farm, lying near the turnpike-road between Cheltenham and Tewkſbury, in the Vale of Glouceſter. The ſtem is remarkably collected at the root, the ſides of its trunk being much more upright than thoſe of large trees in general; and yet its circumference at the ground is about 20 paces; meaſuring with a two-foot rule, it is more than 11 yards. At three feet high it is 42 feet, and where ſmalleſt, *i. e.* from five to ſix feet high, it is 36 feet. At ſix feet it ſwells out large, and forms an enormous head, which has been furniſhed with huge, and probably extenſive, arms. But time and the fury of the wind have robbed it of much of its grandeur; and the greateſt extent of arm in 1783 was eight yards from the ſtem.

In the Gentleman's Magazine for May 1794 we have an account of an oak tree growing in Penſhurſt park in Kent together with an engraving. It is called the *Bear* or *Bear oak*, from being ſuppoſed to reſemble that which Camden thought gave name to the county of Berkſhire. The tradition at Penſhurſt is that it is the very tree planted on the day that the celebrated Sir Philip Sydney was born. "Some late writers (ſays Mr Rawlet) have queſtioned this, and think that to have been a different tree, which was cut down ſome years ago, and was indeed much larger than this. I remember being once in the hollow of the preſent oak with the late Sir John Cullum; and his opinion then was, that its antiquity was greater than the period aſſigned. But, I aſſure you, the tradition of this place is conſtant for this tree; and, in confirmation of it, an old lady of 94 years of age, now living, has told me, that all the tenants uſed to furniſh themſelves with boughs from this tree, to ſtick in their hats, whenever they went to meet the earls of Leiceſter, as was always the cuſtom to do at the end of the park when they came to reſide at their ſeat here. This fine old oak ſtands upon a plain about 500 yards from their venerable manſion, near a large piece of water called *Lancup-well*. Ben Jonſon and Waller have particularly noticed it; and, from the diſtinguiſhed owners of this place, it may be truly ſaid to ſtand on claſſic ground. Within the hollow of it there is a ſeat, and it is capable of containing five or ſix perſons with eaſe. The bark round the entrance was ſo much grown up, that it has lately been cut away to facilitate the acceſs. The dimenſions of the tree are theſe:

	Feet.	Inches.
Girth cloſe to the ground - -	35	6
Ditto one foot from ditto -	27	6
Ditto five feet from ditto - -	24	0
Height taken by ſhadow -	73	0
Girth of loweſt, but not largeſt, limb	6	9

With reſpect to longevity, Linnæus gives account of an oak 260 years old: but we have had traditions of ſome in England (how far to be depended upon we know not) that have attained to more than double that age. Mr Marſham, in a letter to Thomas Beever, Eſq; Bath Papers, Vol. I. p. 79, makes ſome very ingenious calculations on the age of trees, and concludes from the increaſe of the Bentley oak, &c. that the Fortworth cheſnut is 1100 years old.

Beſides the grand purpoſes to which the timber is applied in navigation and architecture, and the bark in tanning of leather, there are other uſes of leſs conſequence, to which the different parts of this tree have been referred. The Highlanders uſe the bark to dye their yarn of a brown colour, or, mixed with copperas, of a black colour. They call the oak *the king of all the trees in the foreſt*; and the herdſman would think himſelf and his flock unfortunate if he had not a ſtaff of it. The acorns are a good food to fatten ſwine and turkeys; and, after the ſevere winter of the year 1709, the poor people in France were miſerably conſtrained to eat them themſelves. There are, however, acorns produced from another ſpecies of oak, which are eaten to this day in Spain and Greece, with as much pleaſure as cheſnuts, without the dreadful compulſion of hunger.

Quercus Marina, the *Sea Oak*, in botany, the name of one of the broad-leaved dichotomous ſea-fucuſes. It is not agreed, among the late botaniſts, what was the ſea oak of Theophraſtus; and the moſt ancient botaniſts, Cluſius and Cæſalpinus, ſuppoſe it to have been a ſpecies of the ſhrubby coralline; but that ſeems by no means to have been the caſe, ſince Theophraſtus ſays his ſea oak had a long, thick, and fleſhy leaf; whence we may much more naturally conclude it to have been of the fucus claſs.

QUERIA, in botany: A genus of the trigynia order, belonging to the triandria claſs of plants; and in the natural method ranking under the 22d order, *Caryophyllei*. The calyx is pentaphyllous; there is no corolla; the capſule is unilocular, and trivalved, with one ſeed. There are two ſpecies, *viz*. hiſpanica and canadenſis.

QUESNE (Abraham du), marquis of Queſne, admiral of the naval forces of France, and one of the greateſt men of the laſt age, was born in Normandy in 1610. He contributed to the defeating of the naval power of Spain before Gattari; was dangerouſly wounded before Barcelona in 1642, and on other occaſions: he went into the ſervice of the Swedes, and became vice-admiral; gave the Danes an entire defeat, killed their admiral, and took his ſhip. He was recalled into France in 1647, and commanded the ſquadron ſent to Naples. The ſea-affairs of France being much fallen, he fitted out divers ſhips for the relief of the royal army that blocked up Bourdeaux; which was the principal cauſe of the ſurrender of the town. He was very fortunate in the laſt wars of Sicily, where he beat the Dutch thrice, and De Ruyter was killed. He alſo obliged the Algerines to ſue for peace from France in a very humble manner. In ſhort, Aſia, Africa, and Europe, felt the effects of his valour. He was a Proteſtant; yet the king beſtowed on him the land of Bouchet, and to immortalize his memory gave it the name of that great man. He died in 1688.

QUESTION, in logic, a propoſition ſtated by way of interrogation.

QUESTION, or *Torture*. See RACK.

QUESTOR, or QUÆSTOR, in Roman antiquity, an officer who had the management of the public treaſure.

The queſtorſhip was the firſt office any perſon could bear in the commonwealth, and gave a right to ſit in the ſenate.

At firſt there were only two; but afterwards two others were created, to take care of the payment of the armies abroad, of ſelling the plunder, booty, &c. for which purpoſe they generally accompanied the conſuls in their expeditions; on which account they were called *peregrini*, as the firſt and principal two were called *urbani*.

The number of the queſtors was afterwards greatly increaſed. They had the keeping of the decrees of the ſenate: and hence came the two officers of *queſtor principis*, or *auguſti*, ſometimes called *candidatus principis*, whoſe office reſembled in moſt reſpects that of our ſecretaries of ſtate; and the *queſtor palatii*, anſwering in a great meaſure to the Engliſh lord-chancellor.

QUEUE, in heraldry, ſignifies the tail of a beaſt: thus, if a lion be born with a forked tail, he is blazoned double-queued.

QUEVEDO de VILLEGAS (Franciſco), a celebrated Spaniſh poet, born at Madrid in 1570. He was deſcended from a noble family, and was made a knight of St James; but was thrown into priſon by order of Count Olivarez, whoſe adminiſtration he ſatirized in his verſes, and was not ſet at liberty till after that miniſter's diſgrace. Quevedo wrote ſome heroic, lyric, and facetious poems. He alſo compoſed ſeveral treatiſes on religious ſubjects, and has tranſlated ſome authors into Spaniſh. He died in 1645. The moſt known of his works are, 1. The Spaniſh Parnaſſus. 2. The Adventurer Buſcon. 3. Viſions of Hell Reformed, &c. Quevedo was one of the greateſt ſcholars and moſt eminent poets of his time. His youth was ſpent in the ſervice of his country in Italy, where he diſtinguiſhed himſelf with the utmoſt ſagacity and prudence. His moral diſcourſes prove his ſound doctrine and religious ſentiments, while his literary pieces diſplay his infinite judgment and refined taſte. His great knowledge of Hebrew is apparent from the report of the hiſtorian Mariana to the king, requeſting that Quevedo might reviſe the new edition of the Bible of Arias Montanus. His tranſlations of Epictetus and Phocylides, with his imitations of Anacreon, and other Greek authors, ſhow how well he was verſed in that language: that he was a Latin ſcholar, his conſtant correſpondence, from the age of twenty, with Lipſius, Chifflet, and Scioppius, will ſufficiently illuſtrate. As a poet, he excelled both in the ſerious and burleſque ſtyle, and was ſingularly happy in that particular turn we have ſince admired in Butler and Swift. His library, which conſiſted of about five thouſand volumes, was reduced at his death to about two thouſand, and is preſerved in the convent of St Martin at Madrid.

QUICK, or *Quickset Hedge*, among gardeners, denote all live hedges, of whatever ſort of plants they are compoſed, to diſtinguiſh them from dead hedges; but in a more ſtrict ſenſe of the word, it is reſtrained to thoſe planted with the hawthorn, under which name thoſe young plants or ſets are ſold by the nurſery-gardeners who raiſe them for ſale. See the article HEDGES.

QUICKLIME, a general name for all calcareous ſubſtances when deprived of their fixed air; ſuch as chalk, limeſtone, oyſter-ſhells, &c. calcined. See CHEMISTRY, n° 511, 748, 837, and 914.

Quicklime has the following properties. 1. It is entirely ſoluble in water, with which it unites ſo rapidly as to occaſion conſiderable heat. When expoſed to air, it imbibes moiſture from thence. When united with as much water as is ſufficient to make it a fluid paſte, it is called *ſlaked lime*. Water ſaturated with quicklime is called *lime-water*. According to Brandt, lime-water contains about one part of quicklime to 700 or 800 parts of water. Slaked lime, or lime-water, being expoſed to the atmoſphere, attract from thence particles of fixable air which float in it, by which means the quicklime is rendered mild, inſoluble in water, and therefore appears on the ſurface of the lime-water, or of the ſlaked lime where this combination happens, in the ſtate of mild or combined calcareous earth, convertible by a ſecond calcination into quicklime, and is called *cream of lime*.

If the earth diſſolved in lime-water be precipitated from thence by any ſubſtance containing fixable air, as by mild alkalis or magneſia, it will unite with this air, become mild, and reſume its former weight and properties which it poſſeſſed before calcination. But if it be precipitated from the water by means of ſome ſubſtance which does not contain fixable air, but which is more ſtrongly diſpoſed than the earth to unite with the water, for inſtance, ſpirit of wine, the earth thus precipitated will be in the ſtate of quicklime, that is, cauſtic, and ſoluble in water.

2. Quicklime unites with acids without efferveſcence, which is nothing elſe than an extrication of the fixable air, of which quicklime has been already deprived. It nevertheleſs ſaturates as much acid as it would have done if it had not been calcined.

3. Quicklime is more powerfully diſpoſed to unite with fixable air than fixed or volatile alkalis, or magneſia. Hence, when treated with theſe ſubſtances, it takes from them their fixable air, and is itſelf rendered mild, and reſtored to its original weight and properties. Thus two drams of chalk, having been by calcination reduced to one dram and eight grains of quicklime, were thrown into a filtrated ſolution of an ounce of mild fixed alkali in two ounces of water, and digeſted during ſome time; by which the calcareous earth became mild, and weighed one dram and 58 gr. By means of magneſia, the calcareous earth may be precipitated from lime-water; and this earth is found to be mild, and to have deprived the magneſia of its fixable air. By depriving alkalis of their fixable air, quicklime renders them more cauſtic and ſolvent, for the ſame reaſon that itſelf is by this privation of air rendered more cauſtic and powerfully ſolvent. This increaſe of cauſticity and diſſolving power is conſiſtent with a general rule, namely, that the more ſimple or leſs compounded any body is, that is, the leſs its general tendency to union is ſatisfied, the more diſpoſed it is to unite with or diſſolve other ſubſtances.

4. Quicklime has a diſpoſition to unite with ſulphur, with which it forms a hepar of ſulphur, ſimilar to that made by ſulphur united with an alkali, and, like this, ſoluble in water. It is alſo diſpoſed to unite with oils and with animal and vegetable matters, with reſpect to which it diſcovers a cauſtic and corroſive property.

5. Quicklime mixed with ſand forms a maſs which hardens, and is uſed as a cement or mortar.

All theſe properties of quicklime have been the objects of conſideration to the chemiſts and philoſophers; who have, as uſual, been divided in their opinions on the ſubject. The evident reſemblance of the action of quicklime to fire, has given occaſion for one party to derive all the active properties of this ſubſtance from fire; while, on the other hand, its want of heat, and incapacity of ſetting bodies on fire, unleſs by an acceſſion of water, were objections altogether inſurmountable. On the other hand, thoſe who denied the materiality of fire, and affirmed that it conſiſts only in a motion mechanically produced among the particles of bodies, were altogether at a loſs to ſhow a reaſon why this motion, or any thing reſembling it, ſhould continue perhaps for months after the exciting cauſe is taken away. To remove this difficulty, ſome have had recourſe to the action of a latent acid communicated to the quicklime by the fire; and which one chemiſt (Mr Meyer) has diſtinguiſhed by the name of *acidum pingue*. But on this hypotheſis it may be remarked in the firſt place, that the action of acids is as difficult to be explained as that of fire; and, in the ſecond place, that as all ſubſtances, by calcination into quicklime, loſe conſiderably of their weight, it ſeems very improbable that they ſhould acquire an acid or any other ſubſtance which could increaſe their weight. Beſides, from the experiments of Dr Black, it appears that the diminution of weight in calcareous ſubſtances is owing to their parting with a quantity of fixed air, the weight of which is much more conſiderable than that of any moiſture or fatty matter they contain. The loſs of this fixed air is now alſo univerſally allowed to be the reaſon of the cauſticity of the quicklime, as its ſuperior attraction for fixed air is looked upon to be the reaſon why it renders fixed and volatile alkalis cauſtic like itſelf. The only queſtion therefore can be, By what means are the calcareous earths deprived of their fixed air? To this queſtion the anſwer is evident, namely, that the action of the fire expels the fixed air; and if this is the caſe, it is evident, that to this action of fire, continued, the cauſtic properties of the lime are owing.

We come now to the diſcuſſion of the queſtion, Whether quicklime is to be conſidered as a pure earth, or a combination of it with ſomething elſe?—Moſt of the chemiſts, ſince the diſcovery of fixed air, have been inclined to think that quicklime is a pure earth uncombined with any thing elſe, and that it approaches more nearly to the ſtate of elementary earth than any other. But this opinion ſeems not to have a ſolid foundation; for there are other earths, ſuch as the baſis of alum, which as far as they can be examined by us, are equally pure with quicklime, and yet diſcover not the ſmalleſt cauſticity, even after the moſt violent calcination. Beſides, from the property which quicklime has of depriving alkaline ſalts of their fixed air, we may learn, that there exiſts in it, when kept by itſelf, a certain principle which prevents it from abſorbing again the fixed air, with which it was once ſo cloſely united, except in certain circumſtances. It is well known, that fixed alkalis, as well as thoſe which are volatile, will abſorb fixed air from the common atmoſphere; and hence, tho' they are prepared in the moſt cauſtic ſtate, they will in a very ſhort time become mild by an expoſure to the atmoſphere; nay, it requires no ſmall degree of care to prevent the atmoſphere from having as much acceſs to them as is neceſſary to change them from a cauſtic to a mild ſtate. Now, as theſe ſubſtances thus attract the fixed air from the atmoſphere, it thence appears that the atmoſphere parts very readily with the fixed air which it contains. The quicklime, however, though it has a greater attraction for fixed air than the alkalis, yet does not become near ſo ſoon mild from expoſure to the air as the alkalis which have leſs attraction than itſelf. Hence the neceſſary inference muſt be, that quicklime, after being once calcined, inſtead of attracting, repels fixed air, unleſs it is placed in certain circumſtances, wherein the repelling power is deſtroyed, and the attractive power again manifeſts itſelf. Now it is manifeſt, that the power which originally repelled the fixed air was the action of fire; and conſequently, while the quicklime refuſes to attract fixed air, we muſt conclude that it is the ſame action which prevents the union. Quicklime therefore is not a pure earth, but a combination of a pure earth with fire; juſt as chalk, or limeſtone uncalcined, is not a pure earth, but a combination of a pure earth with fixed air. In all chemical trials, then, where quicklime is uſed, the double elective attraction will manifeſt itſelf as much as in a combination of different ſalts, metals, and acids. Thus when water is poured on quicklime, the attraction between that element and earth is ſtronger than the attraction between earth and fire. The conſequence is, that the water expels the fire, juſt as vitriolic acid poured upon ſea-ſalt expels the marine acid. The fire, then, having nothing with which it can form a chemical combination, becomes ſenſible to the touch, firſt making the lime very hot, and then gradually diſſipating in the atmoſphere. However, as the water combines with the earth but in very ſmall quantity, it can only expel the fire from that quantity with which it does combine; and conſequently the lime ſtill retains its cauſtic quality, though in a degree ſomewhat milder than what it was originally. We muſt alſo conſider, that water itſelf has a conſiderable attraction for fire as well as for earth; and the conſequence of this muſt be, that part of the lime will be diſſolved in the water, if more of that element is added than what the earth can abſorb without loſing the form of a dry powder. Hence the origin of lime-water, which is only a ſmall quantity of lime in its cauſtic ſtate diſſolved in a large quantity of water. This diſſolution is owing to the double attraction of fire to earth and water; for as long as the water can admit the calcined earth to that intimate union with itſelf which is called a *chemical combination*, the earth muſt ſtill retain all the cauſticity which the fire gives it, and diſſolve in the water. When the earth is in too large quantity to be thus combined with the water, the latter is only abſorbed into the pores of the earth, where by its bulk it ſplits the ſtone or calcined matter all to pieces, and reduces it to an impalpable powder, expelling a proportionable quantity of fire from thoſe pores which it now occupies. The water, however, is capable of radically diſſolving but a very ſmall portion of calcined earth: and therefore the ſame quantity of quicklime will ſerve for preparing lime-water a great number of times over; but at laſt a large quantity is left, which ſeems to be quite inert, and has loſt the properties of quicklime. Thoſe who have tried the experiment of lixiviating lime with freſh quantities of water till it ceaſes to be ſoluble, have fixed the proportion of ſoluble matter in the lime at about one-third of the whole; but from Dr Black's experiments it appears that quicklime may all be diſſolved in water at once, provided the water is in ſufficient quantity. Its inactivity, therefore, after repeated affuſions of water, muſt be owing to ſome change produced by the water; but whether this is owing to an abſorption of all the fire it contained by the great quantity of water, or to a ſupply of fixed air given by the water, has not yet been determined by an experiment.

If, inſtead of pouring cold water upon quicklime, we pour that which is already heated, the abſorption is much leſs complete; becauſe the water, having already a ſuperfluous quantity of heat, is reſiſted by that which is contained in the quicklime in a latent ſtate; and hence it is a general obſervation, that hot water is leſs proper for ſlaking lime than cold. But if we pour on any acid upon quicklime which contains a great quantity of fire in a latent ſtate, and has likewiſe a violent attraction for the earth, a much greater degree of heat is produced than with ſimple water. With the vitriolic acid, indeed, this is not ſo well perceived, if the common calcareous earths are made uſe of; becauſe their inſolubility in this acid diminiſhes its effect: but if, inſtead of theſe earths, we take magneſia newly calcined, the heat is ſo great, that the aqueous vapour, not having time to evaporate ſlowly, is driven off with a conſiderable exploſion. If the common calcareous earths, well calcined, are diſſolved in the nitrous acid, a moſt violent degree of heat is produced; more indeed than in any other caſe where a liquid is concerned: for the nitrous acid itſelf contains a great deal of latent heat; the quicklime does the ſame; and by the intimate union of the earth with the acid, all this latent heat, at leaſt a great part of it, both in the quicklime and ſpirit of nitre, is diſplaced, and attacks the aqueous fluid, as being neareſt to it; from whence it is diſſipated in the air, or abſorbed by the neighbouring ſubſtances. The ſame thing happens, only in a leſs degree, when the marine acid is employed.

When quicklime is mixed with a ſolution of mild alkali, a double decompoſition, and two new compoſitions, take place. The quicklime may be conſidered as a combination of earth and fire, while the alkali in the preſent caſe acts as a combination of ſalt and air. Theſe two ſubſtances, therefore, are no ſooner put into ſuch circumſtances as enable them to act on each other, than the quicklime attracts the air from the alkali, and gives its own fire in exchange, which the alkali takes up, and thus is rendered cauſtic, while the quicklime becomes mild. Nevertheleſs, though the alkali here ſeems to have the greater attraction for fire, and the quicklime for air; yet it appears that the alkali is by no means capable of keeping the fire which it has imbibed for any length of time: for no ſooner is it expoſed to the action of the air, than it parts with the fire which it had imbibed, regains its air, and becomes mild. This, however in all probability is owing to its extreme ſolubility in water while in a cauſtic ſtate; for quicklime itſelf, when diſſolved in water very eaſily regains its fixed air, nay even more than it contains in a natural ſtate. See the article SALT.

On the whole, then, the properties of quicklime may be explained in a very eaſy manner on Dr Black's principle of latent heat. That heat conſiſts in a latent ſtate in quicklime, as well as in vapour, we have inconteſtable proofs; becauſe, in all caſes where quicklime changes its nature and becomes more mild, a degree of heat is produced, and which is always proportionable to the change made on the quicklime. In the making of quicklime, therefore, the air is expelled, and a proportional quantity of fire enters; in diſſolving it in an acid, ſlaking, &c. an acid, air, or water, expels part of the heat, which then becomes ſenſible. By long expoſure to the air, the heat gradually evaporates; the fixed air reſumes its place; and the quicklime being thus increaſed in bulk, embraces thoſe bodies very cloſely which lie neareſt to it; inſomuch that, when mixed with ſand and ſtones, it will harden with them almoſt into the ſolidity of a rock (ſee CEMENT and MORTAR). When mixed with animal or vegetable ſubſtances, it deſtroys or decompounds them, both by the action of its internal heat, and by its attraction for a certain acid contained in the animal ſubſtances, and an oily matter in the vegetables; and hence its property of burning cloth, though its attraction for the oily matter juſt mentioned makes it an excellent whitener when properly applied. See BLEACHING.

QUICKSILVER, or MERCURY, one of the perfect metals, and ſo fuſible that it cannot be reduced to a ſolid ſtate but by the moſt intenſe degree of cold, ſcarcely, if at all, under 40° below 0 of Fahrenheit's thermometer. See CONGELATION. For the method of extracting quickſilver from its ore, &c. ſee METALLURGY, p. 454, and 475. For the various preparations, &c. from it, ſee CHEMISTRY *Index* at *mercury* and *quickſilver*, and PHARMACY *Index* at *mercury* and *quickſilver*. And for its uſe in medicine, ſee MEDICINE, n° 350, and MERCURY.

It is found, 1. Native, as in the mines of India, Friuli, Lower Auſtria, Deux Ponts, &c. flowing through beds of ſtone, and collecting in the clifts or cavities of rocks. In theſe mines, however, Mr Kirwan is of opinion that it is mixed with ſome other metal, as the globules into which it is divided are not perfectly ſpherical. In Sweden and Germany it has been found united to ſilver in form of a hard and ſomewhat brittle amalgam. It has alſo been obſerved viſibly diffuſed through maſſes of clay or ſtone, of a white, red, or blue colour, and very heavy in Spain and Idria; and in Sicily in beds of chalk.

Mines of quickſilver, however, are very rare, inſomuch that, according to the calculations of Hoffman, there is 50 times more gold got every year out of the mines than mercury and its ores. But Dr Lewis, in his notes upon Newmann, ſays, that Cramer ſuſpects that Hoffman only meant five times inſtead of 50; but neither the Latin nor the Engliſh edition of this author expreſſes any ſuch thought; on the contrary, he adopts the ſame opinion; and only adds, that mercury is much more frequently met with than is commonly believed; but being ſo volatile in the fire, it often flies off in the roaſting of ores, and eſcapes the attention of metallurgiſts.

According to Newmann, the mines of Idria have produced at the rate of 231,778 pounds weight of mercury *per annum*; but thoſe of Almaden in Spain produce much more. The chemiſts of Dijon inform us, that their annual produce is five or ſix thouſand quintals, or between five and ſix hundred thouſand pounds weight. In the year 1717 there were upwards of 2,500,000 pounds of quickſilver ſent from them to Mexico, for the amalgamation of the gold and ſilver ores of that country.

At Guacanvelica in Braſil the annual produce of the mines, according to Bomare, amounts to one million of pounds, which are carried over land to Lima, thence to Arica, and laſtly to Potoſi for the ſame purpoſe.

Beſides theſe mines there are others in Braſil near Villa Rica, where ſuch a quantity of cinnabar and native running mercury are found near the ſurface of the earth, that the black ſlaves often collect it in good quantities, and ſell it for a trifling price to the apothecaries; but none of theſe mines have ever been worked or taken notice of by the owners. Gold naturally amalgamated with mercury is likewiſe met with in the neighbourhood of that place; and it is ſaid that almoſt all the gold mines of that country are worked out by ſimply waſhing them out with running water, after reducing into powder the hard ores, which are ſometimes imbedded in quartzoſe and rocky matrices.

In the duchy of Deux Ponts and in the Lower Auſtria the quickſilver flows from a ſchiſtoſe or ſtony matrice, and is probably, ſays Mr Kirwan, mixed with ſome other metal, as its globules are not perfectly ſpherical. The mines of Friuli are all in ſimilar beds or ſtrata. The metal is likewiſe found viſibly diffuſed through maſſes of clay or very heavy ſtone, of a white, red, or blue colour; of which laſt kind are the mines of Spain, ſome of Idria, and of Sicily. Maſcagni found fluid quickſilver, as well as native cinnabar and mineral ethiops, near the lake of Travale in the duchy of Sienna; but the quantity was ſo ſmall as not to be worth the expence of working. On the other hand, the following mines afford profits to the owners after clearing all expences, viz. thoſe at Kremnitz in Hungary; at Horowitz in Bohemia; Zorge in Saxony; Wolfſtein, Stahlberg, and Moeſchfeld in the Palatinate. Mercury is alſo brought from Japan in the Eaſt Indies; but the greateſt part of what is ſold in Europe as Japan cinnabar is ſaid to be manufactured in Holland.

Lemery, Pomet, and others, lay down ſome external marks by which we may diſtinguiſh thoſe places where there are mines of quickſilver, viz. thick vapours like clouds ariſing in the months of April and May; the plants being much larger and greener than in other places: the trees ſeldom bearing flowers or fruit, and putting forth their leaves more ſlowly than in other places; but, according to Neumann, theſe marks are far from being certain. They are not met with in all places where there is quickſilver, and are obſerved in places where there is none. Abundance of theſe cloudy exhalations are met with in the Hartz foreſt in Germany, though no mercury has ever been found there; to which we may add, that though vaſt quantities of mercurial ores are found at Almaden in Spain, none of the abovementioned indications are there to be met with.

Native mercury was formerly ſought from the mines of Idria with great avidity by the alchemiſts for the purpoſe of making gold; and others have ſhowed as ridiculous an attachment to the Hungarian cinnabar, ſuppoſing it to be impregnated with gold; nay, we are informed by Neumann, that not only the cinnabar, antimony, and copper of Hungary, but even the vine trees of that country were thought to be impregnated with the precious metal. Not many years ago a French chemiſt advertiſed that he had obtained a conſiderable quantity of gold from the aſhes of vine twigs and ſtems, as well as of the garden ſoil where they grew; but the falſehood of theſe aſſertions was demonſtrated by the count de Lauragais to the ſatisfaction of the Royal Academy of Sciences.

The reduction of mercury into a ſolid ſtate, ſo that it might be employed like ſilver, was another favourite alchemical purſuit. But all proceſſes and operations of this kind, ſays Neumann, if they have mercury in them, are no other than hard amalgams. When melted lead or tin are juſt becoming conſiſtent after fuſion, if a ſtick be thruſt into the metal, and the hole filled with quickſilver, as ſoon as the whole is cold, the mercury is found ſolid. Macquer informs us, that mercury becomes equally ſolid by being expoſed to the fumes of lead. Maurice Hoffman, as quoted by Neumann, even gives a proceſs for reducing mercury, thus coagulated, to a ſtate of malleability, viz. by repeatedly melting and quenching it in lintſeed oil. Thus, he tells us, we obtain a metal which can be formed into rings and other utenſils. But here the mercury is entirely diſſipated by the repeated fuſions, and nothing but the original lead is left. Wallerius, after mentioning ſtrong ſoap-leys, or cauſtic lixivium, and ſome other liquors proper for fixing quickſilver, tells us, that by means of a certain gradatory water, the compoſition of which he learned from Creuling *de Aureo Vellere*, he could make a coagulum of mercury whenever he pleaſed, of ſuch conſiſtency that great part of it would reſiſt cupellation; but what this gradatory water was, he has not thought proper to lay before the public.

2. Native precipitate *per ſe*, in which the metal is mineralized by aerial acid. This was lately found in Idria, in hard compact maſſes of a browniſh red colour and granular texture, mixed with ſome globules of native mercury. An hundred parts of it afford 91 of running mercury.

Various little globules of mercury were contained in this ore, which are rendered very viſible by being heated, but are ſoon reabſorbed by cooling. On expoſing it to the fire in an iron ſpoon, the red colour ſoon became more vivid, but turned yellowiſh on cooling. Diſtilled in a pneumoniac apparatus, a quantity of dephlogiſticated air was produced, though leſs by one fourth than what ſhould have been produced by an equal quantity of cinnabar. On diſtilling an ounce of this ore in a glaſs retort, a little yellow powder was left, which weighed a fourth part of a grain, and ſtained the bottom of the retort in a manner ſimilar to what is done by the calx of ſilver to white glaſs in ſimilar circumſtances. On cupelling this powder with 144 grains of lead wrapped up in paper, the increaſed weight of the lead over that of the teſt of compariſon ſhowed that the calx was reduced into its metallic ſtate of ſilver and mixed with that of lead.

3. Mineraliſed by the vitriolic and marine acids. This kind of ore was firſt diſcovered in the year 1776, at Obermoſchal in the duchy of Deux Ponts. It has a ſpar-like appearance, and is either bright and white, or yellow or black, and mixed with cinnabar in a ſtony matrix. The native marine ſalt of mercury is in the ſtate of corroſive ſublimate.

4. Native cinnabar, in which the metal is mineraliſed by ſulphur. This is of different ſhades from a yellowiſh to a deep red; and is found either pure in hard friable maſſes, either ſhapeleſs or cryſtalliſed in cubes, and ſometimes tranſparent, or intermixed with clay or ſtone, or interſperſed through the ores of other metals, particularly thoſe of ſilver, copper, or martial pyrites. Its texture is either radiated, ſtriated, ſcaly, or granular. An hundred parts of cinnabar contain about 80 of mercury and 20 of ſulphur; but artificial cinnabar contains a little more ſulphur, and hence its colour is darker. Its ſpecific gravity is about 7.000; it ſublimes in cloſe veſſels, and is decompoſed and volatilized in open ones. It is found in the duchy of Deux Ponts, in the Palatinate, in Hungary, Friuli, and Almaden in Spain, and in ſouth America, eſpecially at Guancavelica in Peru. It is ſometimes compact, and ſometimes found in tranſparent, ruby-coloured cryſtals, and often in a kind of ſcales or flattened laminæ. It is called native vermilion, and cinnabar in flowers, when it is in the form of a very bright red powder. It is alſo found in different earths, in ſelenite mixed with iron, with pyrites,

and with ſulphur. Mr Fourcroy enumerates the following varieties: 1. Tranſparent cinnabar, red and cryſtallized in very ſhort triangular priſms, terminated by triangular pyramids. 2. Tranſparent red cinnabar, in octohedral cryſtals, conſiſting of two triangular pyramids united at their baſes and truncated. 3. Solid compact cinnabar, of a brown or bright red; it is ſometimes foliated. 4. Red cinnabar diſtributed in ſtriæ, on a ſtony matrix, or on ſolid cinnabar. It is ſometimes compoſed of needles like cobalt. 5. Cinnabar in flowers, or native vermillion. It is of a bright red colour, and ſatin appearance, adhering to different matrices, in form of a very fine powder. It is ſometimes cryſtallized in very ſmall needles, and then greatly reſembles the foregoing.

The finer coloured ores of mercury are never worked for extracting the metal, but uſed entirely as pigments; but they have been very injudiciouſly preferred for medicinal uſes to the more pure factitious cinnabars; for we ſeldom meet with any native cinnabar that has not ſome earthy or ſtony matter intermixed with it, nor with two pieces that perfectly agree. There are three varieties principally diſtinguiſhed in the ſhops; viz. 1. Cinnabar in maſſes weighing from one to ſix ounces or more. 2. In grains, prepared by breaking the worſe coloured maſſes, and picking out the beſt coloured bits. 3. Waſhed cinnabar, prepared by waſhing over the lighter impurities that are to be found in it. No native cinnabar ſhould ever be employed in medicine without being previouſly purified by ſublimation. Neumann informs us that he never met with any native cinnabar which did not leave a grey aſh or ſand, amounting, among different parcels, from one ninth to one fifth of the mineral employed. The reſiduum had no gold in it, though the colour of its ſolution and precipitate gave ſome expectation of it at firſt ſight.

Neumann remarks, that though vitriolic acid forms with mercury a lively yellow concrete, viz. turbith mineral, and with the inflammable principle a yellow ſulphur; and though ſulphur itſelf forms with mercury a beautiful red cinnabar; yet the ſame vitriolic acid deſtroys the red colour entirely, rendering it as white as milk. This change is not immediately produced on common cinnabar by the vitriolic acid; but, on being digeſted over a ſtrong ſand heat in a glaſs cup, it ſoon becomes as white as cream; and the vitriolic acid takes the form of a ſtrong ſulphureous and volatile vapour, very ſuffocating and corroſive; emitting very piercing fumes for ſome time, which turned the paper that covered it black, and deſtroyed its texture.

5. Black ore of mercury, in which the metal is mineralized by ſulphur and copper. This is of a blackiſh grey colour, a glaſſy texture, brittle, heavy, and decrepitating ſtrongly when heated. It is found at Muſchel Lanſberg. An ore of this kind is alſo found in the duchy of Deux Ponts. In the ſulphur of Idria a black cinnabar is likewiſe ſaid to be found, which retains its colour in ſublimation; but this is not yet ſufficiently confirmed, though it is too bold an aſſertion of Dr J. R. Forſter that no ſuch cinnabar has ever been found. He adds, that a certain learned man thought he had diſcovered ſome near the copper ores at Lauterberg; but that it proved to be a red copper calx, which is ſtill to be met with in that place.

6. Pyritous mercurial ore was brought from Dauphiny by Mr Montigny in 1768. It is grey, whitiſh, and friable. An hundred parts yielded one of mercury, one half of ſilver, the remainder being iron, cobalt, ſulphur, and arſenic.

7. An ore of mercury, in which the metal is mineralized with iron by ſulphur, is mentioned by Sir Torbern Bergman in his *Sciagraphia*, ſect. 177. He ſays that it is doubtful whether this does not belong to the ſpecies of cinnabar, as the iron is perhaps only mechanically diffuſed thereon. Mr Mongez informs us, that there are but few inſtances of cinnabar in which iron is not found in its calcined form, though, in the act of the ore being reduced, it paſſes to its metallic ſtate, and becomes capable of being acted upon by the loadſtone.

Another pyritous ore of cinnabar was found at Menidot, near St Lo in Lower Normandy. It conſiſted of differently ſized grains of a red brown colour: they had a vitriolic taſte and ſulphureous ſmell. Pyritous ores of this kind are likewiſe found at Almaden in Spain, and at Stahlberg in the Palatinate. The cinnabaric pyrites of this laſt place are of a dodecaedral form.

8. Mr Gellert informs us, that an ore of quickſilver is met with in Idria, where the mercury lies in an earth or ſtone, as if it were in a dead form; and has the appearance of a red-brown iron-ſtone, but much heavier. It contains from three quarters to ſeven-eighths of the pureſt mercury, leaving after diſtillation a very black ſtrong earth, giving alſo ſome marks of cinnabar. For, as we do not know the ultimate diviſibility of mercury, we cannot juſtly determine the point of its fluidity, although its globules may be no more diſcernible.

The *liver-ore*, which is moſt common in Idria, and has its name from its colour, reſembles an indurated iron-clay; but its weight diſcovers it to have metallic contents. An hundred weight of it ſometimes yields 80 pounds of quickſilver.

The *brand-erz*, or burning ore of the Germans, likewiſe belongs to this ſpecies. It may be lighted at a candle, and yields from 9 to 50 pounds of metal in the 100.

9. Dr Gmelin informs us, that cinnabar mixed with arſenic or realgar is ſaid to be found in Japan; and that at Morsfield the cinnabar and white calx of arſenic preſent themſelves in the ſame rock.

10. Beſides the ores already mentioned, we ſometimes meet with quickſilver natively amalgamated with gold, ſilver, and other metals. This is taken notice of by Bergman; and from the authorities of Monet and Prof. Gmelin, Mr Kirwan informs us, that in Sweden and Germany this metal has been found united to ſilver in an hard brittle amalgam. M. de L'Iſle had a ſpecimen of this ore from Germany; which, as M. Mongez informs us, is imbedded in a quartzoſe maſs, and mixed with cinnabar. A ſpecimen brought from the mine called *Carolina*, in a cryſtalline form, was depoſited in the royal cabinet at the king's garden at Paris. M. de L'Iſle likewiſe informs us, that a ſpecimen of native gold was brought from Hungary, which, according to Cronſtedt, was probably an amalgam of mercury and gold. It is compoſed of quadrangular priſms, of a greyiſh yellow colour, and brittle texture. Neumann likewiſe obſerves, that ſometimes a mineral,

containing gold or ſilver, is met with among mercurial ores, though very rarely.

Theſe natural amalgams account for the great ſpecific gravity of ſome kinds of quickſilver. This may proceed from a natural mixture of gold, though, according to Boerhaave, it may alſo ariſe from its being rediſtilled a great number of times. By a ſimilar mode of reaſoning we may conclude, that the ſmalleſt ſpecific gravities of quickſilver proceed from its amalgamation with ſilver, lead, and other metals or ſemimetals, which in ſpite of repeated diſtillations may ſtill preſerve their union with it; for Dr Boerhaave informs us that he could not, by any number of diſtillations, free mercury perfectly either from tin or lead.

M. Magellan, in his notes on Cronſtedt's Mineralogy, ſays, "That mercury is many times found amalgamated with lead, is eaſily evinced by the proceſs of M. Groſſe, mentioned by Macquer in his elements of Chemiſtry, where the method of extracting mercury from ſome ſolutions of lead is deſcribed; but the ſame Macquer, in his Chemical Dictionary, poſitively affirms, that, though Beccher and Kunckel have both given other proceſſes for extracting mercury from lead, and though the method pointed out by M. Groſſe is eaſier than the others, nevertheleſs it does not ſucceed if the lead be quite pure without any amalgamation with mercury. And Boerhaave has expreſsly made the ſame aſſertion, complaining of thoſe authors who affirm the contrary." Dr Black, however, ſeems to be of a different opinion; and, in his public courſe of lectures, teaches that, "by ſome proceſſes of the more difficult kind, mercury may be extracted from lead;" though he cautions us, at the ſame time, not to infer from this, or any other chemical proceſs, the poſſibility of the tranſmutation of metals.

Mercury is not in any way altered by the action of light. Its dilatation by heat is extremely regular, as has lately been ſhown, in a very great variety of experiments, by Dr Adair Crawford; for which reaſon it is uſed as the meaſure of heat, and thermometers are uſually filled with this metal. When oppoſed to the heat of about 600° of Fahrenheit, it boils and is diſperſed in an inviſible fume; which, however, has been obſerved to have the elaſticity of the ſteam of water, and to burſt an iron box in which it was attempted to confine it. If it be made to boil in a cloſe veſſel fitted with a proper apparatus, it will all come over in its proper form, and leave any fixed matter it might contain in the retort. This affords an eaſy method of purifying it from the baſe metals with which it is frequently adulterated; though even in this way it is neceſſary to raiſe the fire cautiouſly, or a part of the fixed metal will be carried up along with the mercury. And even with all the care that can be taken, it has been found impoſſible, as has been already ſaid, to free it perfectly from a mixture of the baſe metals by any number of diſtillations.

By a very great number of diſtillations, however, it was ſaid that ſome change might be made upon this metal; and that it became not only purer, but ſpecifically *heavier*, by ſuch an operation. Boerhaave, after making it undergo this operation 511 times, found ſome difference; but three years after, in a Memoir inſerted in the Philoſophical Tranſactions for 1736, he acknowledged, that, on repeating the operation 877 times, its ſpecific gravity, as ſhown by Dr Graveſande's nice hydroſtatic balance, appeared to be no more than 13.500 to diſtilled water.

"Boerhaave died (ſays Mr Magellan in his Notes on Cronſtedt's Mineralogy) two years after, on the 23d of September 1738; and left his papers to his two nephews, Herman, who died the 7th of October 1753, and Kaw, who died five years after. On their deaths the manuſcripts fell into the hands of Charles Frederick Kruſe phyſician to the Emperor of Ruſſia. This gentleman publiſhed a ſhort extract from Boerhaave's Diary in the ninth volume of the *Novi Commentarii* of the Imperial Academy of Peterſburg, of which the following are the reſults.

"The ſpecific gravity of the pureſt gold to that of diſtilled water is	19,024
That of mercury diſtilled once in a retort	13,570
Diſtilled 1009 times - -	13,590
Once from its amalgam with gold -	13,550
750 times with the ſame amalgam -	13,520
877 times from the ſame - -	13,500
Once from its amalgam with ſilver -	13,550
217 times from the ſame amalgam -	13,500

"It is evident, therefore, by theſe facts, that mercury does not acquire any additional increaſe to its ſpecific gravity by the mere repetition of ſimple diſtillations, nor by its amalgamations with gold or ſilver, provided it be afterwards properly ſaturated by fire."

It is certain, however, that there are very conſiderable differences in the ſpecific gravity of different ſpecimens of quickſilver; and authors have by no means agreed in fixing the ſtandard.—Bergman ſtates it at 14.110; and Muſchenbroek aſſerts that ſuch was the ſpecific gravity of Boerhaave's quickſilver that had been diſtilled 511 times; but ſome modern authors, among whom is M. Fourcroy, ſtate the ſpecific gravity of this metal at no more than 13.000. Modern experiments, however, ſhow that it is generally about 13.500 or 13.600. "This (ſays Mr Magellan) I am informed was the mean ſpecific gravity found by the late Lord Cavendiſh, after the repeated and nice trials he made upon 50 different ſpecimens of quickſilver, on which he employed all his induſtry and attention to determine this point.

"The hydroſtatical experiments I lately undertook of this kind upon ten different ſpecimens of mercury, two of which were revived from natural and artificial cinnabar by the operator of Mr Kirwan, confirmed me in the ſame opinion.

"The temperature of the atmoſphere was nearly the mean, viz. at the 50th degree of Fahrenheit's thermometer; and the ſcales employed were ſo nice, that they turned with the hundredth part of a grain when loaded with four pounds weight.—The method made uſe of to aſcertain theſe ſpecific gravities is the eaſieſt of all. A phial of white glaſs with a ground ſtopple was counterbalanced with lead or other matter in a nice pair of ſcales. The ſubſtance to be tried was introduced into the phial and weighed together, and the weight we ſuppoſe $=a$. The remaining ſpace of the phial being then filled with diſtilled water, we ſuppoſe the weight now to be $=b$. Laſtly, the phial was filled with diſtilled water, and the weight ſuppoſed $=c$. It is evident, that $b - a = d$, the quantity of water in the ſecond operation; $c - d = e$, the water whoſe bulk is equal to that of the ſubſtance; and that $\frac{a}{e}$ is the ſpecific gravity ſought for.—Particular care was taken that no bubble of air remained in the inſide. For this purpoſe a very ſmall groove was made with a file on the inſide of the glaſs ſtopper; and this was introduced ſidewiſe without admitting any air, leaving the ſuperfluous water to ruſh out.

"The greateſt ſpecific gravity of any of thoſe ſpecimens was 13.620, and the leaſt 13.450. The heavieſt was neither of the two that had been diſtilled from cinnabar, but a common quickſilver bought at Apothecaries Hall, London; and the lighteſt was taken from a barometer of the beſt and deareſt kind made by one of the moſt reputed inſtrument-makers in England.

"The moſt obvious cauſe of this difference of ſpecific gravity in quickſilver ſeems to be its mixture or amalgamation with other metals. Certainly, when united to gold, its gravity muſt of courſe be ſpecifically augmented: on the contrary, it muſt be leſſened when united with any other metal, platina only excepted; and the ſame muſt be the caſe whether water or any other moiſture is mixed with it; for in ſuch a caſe the metal will be found heavier after evaporation. A ſimple boiling of the quickſilver over the fire in an open veſſel will completely free it from this mixture; and no careful maker of experiments ſhould neglect the preparation before he undertakes to employ mercury in any proceſs, or for any purpoſe of the philoſophic kind. The boiling muſt be continued for 20 or 30 minutes in order to expel the whole moiſture.

Another cauſe by which the ſpecific gravity of quickſilver becomes ſubject to alteration is the difference of temperature of the atmoſphere at the time of making the experiment. Nor is it quickſilver alone, but every other ſubſtance whoſe ſpecific gravity is affected by this cauſe in a greater or leſſer degree; inſomuch that Mr Magellan does not heſitate to pronounce the labours of all thoſe who have undertaken to compoſe tables of ſpecific gravities, without regard to this circumſtance, to be, if not entirely uſeleſs, at leaſt incapable of affording proper ſatisfaction in the nice inquiries that depend on this knowledge.

In Eiſenchmid's table of ſpecific gravities it is aſſerted, that a cubic inch of mercury in ſummer weighs ſeven ounces, one gros, 66 grains; but in winter it weighs 20 grains more: the whole weight then being ſeven ounces, two gros, 14 grains (allowing 72 grains to the gros). This, however, leaves the matter almoſt in as great uncertainty as before; the ſummer and winter temperature being widely different in different places, and very often even in the ſame place. Unleſs therefore the temperature of the air is attended to at every experiment in taking the ſpecific gravity of any ſubſtance whatever, there can be no certainty of the reſult.

Quickſilver always feels cold when touched in the common temperature of the atmoſphere. Our ſenſations, according to Fourcroy, deceive us in this caſe, for a thermometer dipped in quickſilver always ſhows the common temperature. "The great continuity of contact between the live ſkin and numerous metallic particles in an equal ſpace, and which are proportional to its great ſpecific gravity, neceſſarily produces a ſtronger ſenſation of its own temperature, this being always much leſs than that of a living body; and the multiplicity of theſe points of contact being all at once applied to this organ of ſenſation, muſt be more powerfully felt than whenever we touch any other matter that is lighter in itſelf, or of a leſs denſity."

Notwithſtanding this apparent coldneſs, however, quickſilver, when expoſed to the ſame degree of heat, and in the ſame circumſtances with various other ſubſtances, ſoon becomes hotter to the touch than any of them. "The fundamental principle of this (ſays Mr Magellan) conſiſts in the ſmall quantity of ſpecific fire, or the leſs capacity which mercury is endowed with of receiving heat. This is ſuch, that, compared with the capacity of water for the ſame purpoſe, it is in the ratio of 0.033 to 100, as appears by the table of the quantities of ſpecific fire contained in various bodies.—This table, publiſhed in Magellan's Eſſay on Elementary Fire, was grounded upon various important experiments and obſervations made by Mr Kirwan, in conſequence of the new Theory of Fire diſcovered by Dr Crawford. Hence it follows, that if equal quantities of heat be communicated to equal quantities of water and mercury, the latter will have a temperature 30 times greater than that of the water; that is to ſay, in the inverſe ratio of their reſpective capacities, or as 1 to 30 (=0.033 : 1.000), in the ſame manner as it muſt happen, when equal meaſures of corn or of any fluid are thrown into veſſels whoſe bottoms are as 30 to 1; for then their heights muſt neceſſarily be in their inverſe ratio, viz. of 1 to 30, &c. See CHEMISTRY, n° 1225, &c.

Quickſilver does not appear to diſſolve in water; but Fourcroy remarks, that phyſicians are in the practice of ſuſpending a bag full of it in vermifuge ptiſans during their ebullition, and that experience has evinced the good effects of it. Lemery aſſerts, that in this proceſs there is no loſs of weight; but this is denied by others. Fourcroy aſſerts, that this metal, rubbed between the fingers, emits a perceptible odour, though Magellan ſays he tried the experiment many times without ſucceſs.

Fourcroy likewiſe aſſerts, that mercury when pure emits a phoſphoric light by agitation, particularly in hot ſeaſons. This phenomenon has certainly been obſerved in the mercury of the barometer; but its appearance on other occaſions reſts entirely on the authority of Mr Fourcroy. Even in the barometer it does not take place, unleſs the Torricellian vacuum be not perfectly made in the ſpace at the top of the tube. Phials of glaſs nearly exhauſted of air, and containing ſome quickſilver hermetically ſealed up, will, on being ſhaken, produce as much light in the dark as is ſufficient to ſhow the hour on the dial-plate of a watch. But if a perfect vacuum be produced by nicely boiling the quickſilver within the glaſs, no appearance of this kind is to be perceived. The phenomenon is certainly of the electrical kind; and its not appearing in the perfect vacuum is owing to the difficulty there is in ſetting in motion any large quantity of electric matter by itſelf, which indeed can ſcarce be done without producing very violent effects. See *ELECTRICITY-Index*.

Mercury unites with all the metals and ſemimetals, excepting iron and regulus of antimony. Theſe compounds are called *amalgams*; and Mr Machy has obſerved, that in forming them a certain degree of cold is produced. He made the experiment by covering the ball of a thermometer with tin-foil, and then dipping it into quickſilver; upon which that in the thermometer fell ſome degrees: which agrees perfectly well with the doctrine of latent heat firſt diſcovered by Dr Black, as it ſhows that in this, as well as other caſes, where a body paſſes from a ſolid into a fluid ſtate, a degree of cold is produced.—The following obſervations on the amalgams of mercury with different metals are extracted from the Memoirs of the Academicians of Dijon.

1. The amalgam of gold and mercury cryſtalliſes into quadrangular pyramids. Six ounces of mercury are retained by one of gold in this cryſtallization; but that with ſilver retains a third part more of quickſilver.

2. The amalgam with ſilver is likewiſe ſuſceptible of cryſtallization, and aſſumes the form of a tree; every ounce of ſilver retaining eight of mercury. This amalgam, by means of the nitrous acid, well freed from the vitriolic by ſolution of ſilver in the ſame, forms that curious kind of vegetation mentioned in the article Chemistry, n° 754, called *Arbor Dianæ*, or *Arbor Philoſophorum*.—The following is recommended by Mr Magellan as the ſhorteſt proceſs:

"Diſſolve 228 grains of ſilver, and half as much quickſilver, in pure nitrous acid. Add to the ſolution, when made, five ounces (of 576 grains each) of diſtilled water. Put this ſolution into a ſpherical veſſel of white glaſs, at the bottom of which muſt already be put 432 grains of an amalgam of ſilver of the conſiſtence of butter: let the veſſel be kept in a quiet place, free from any ſhaking or external agitation; and at the end of ſome few hours the figure of a buſh or tree of ſilver will be formed within the water of the glaſs veſſel. The metals contained in the ſolution and in the amalgam attract each other, and a number of ſmall tetrahedral cryſtals are formed, which lay hold at one another's end, and form the appearance of a vegetation.

3. Copper is amalgamated with mercury with great difficulty, and only by mixing blue vitriol with mercury and water in an iron retort over the fire. The acid then attacks the veſſel, and the copper is precipitated in a metallic ſtate, which, by ſtirring it with an hot iron ſpatula, unites to the mercury, but does not cryſtallize.

4. Two ounces of melted lead poured on a pound of mercury produce a half fluid amalgam, which being decanted gives ſome cryſtals like thoſe of ſilver. One ounce of theſe cryſtals retains an ounce and an half of mercury.

5. The amalgam of tin cryſtallizes into thin ſhining lamellæ, with polygonous cavities between one another. Two ounces of tin retain ſix of mercury in this cryſtallization.

6. Mercury amalgamates with biſmuth by means of heat, and produces cryſtals of an octohedral form, and lamellated triangles and hexagons. They are black on the upper ſurface, and ſhining underneath. In this cryſtallization the biſmuth retains double its weight of mercury.

7. *Zinc*, in fuſion, poured upon mercury, produces a crackling noiſe reſembling that produced by a hot body thrown into boiling water. It cryſtallizes very well into lamellated hexagonal figures, leaving cavities among themſelves. One ounce of zinc retains two and an half of mercury in this cryſtallization

8. *Quickſilver* does not amalgamate with arſenic, except by heat, and then only in very ſmall quantity. This metal anſwers very important purpoſes both in medicine and the arts. Though it has no perceptible taſte, it produces very remarkable effects on the ſtomach and inteſtines of animals, as well as on the ſurface of the ſkin. Inſects and worms are extremely ſenſible of this effect, and the metal, almoſt in any ſtate, is exceedingly pernicious to them. Phyſicians, therefore, employ it as an excellent vermifuge (ſee Medicine, p. 341.), and it is likewiſe one of the moſt powerful remedies in the materia medica for many obſtinate diſorders beſides thoſe of the venereal kind, in which its efficacy has long been celebrated. "Even the moſt virulent product of mercury (ſays Mr Magellan), known by the name of ſublimate corroſive, which is the moſt violent poiſon, is often taken internally in very minute doſes, under the direction of ſkilful phyſicians, and produces the moſt happy effects in a great variety of caſes even of the moſt deſperate kind. This is a fact which I have experienced myſelf, in a dreadful ſcorbutic complaint which I ſuffered for above four years, with reſtleſs and violent pains in the eyes and head. None of the moſt able phyſicians in London and Paris I conſulted afforded me any effectual relief, till I had the good fortune to conſult Mr Sacre ſurgeon-oculiſt at Antwerp. His preſcription conſiſted of three grains of ſublimate diſſolved in a pint of common proof ſpirit. The doſe conſiſted in taking every morning two ſpoonfuls of it in a pint of new milk. In leſs than two months I began to feel relief; and in three months time was completely cured. The firſt methodical practice of this remedy was communicated to the celebrated Van Swieten, firſt phyſician to the Emperor's court, by the late Dr A. R. Sanches, then chief phyſician to the court of Peterſburg, as appears by the laſt volume of the Commentaries of the ſame Van Swieten, publiſhed in 1772. This volume was publiſhed after the author's death; but he had enjoyed during his life the glory of being the author of this wonderful remedy, which continues to bear his name among *the ignorant and inaccurate phyſicians* of our times."

But whatever uſes this ſalt may be put to when taken in ſmall quantities, it is certainly not leſs violent than arſenic itſelf, if taken in a large doſe; and the danger is the greater, on account of the difficult ſolution of the ſalt, which requires for this purpoſe 19 times its weight of water. Alkaline ſalts, however, prove a very effectual antidote, and will inſtantly relieve the ſymptoms; but, on account of the inſolubility of the poiſonous ſalt, the diſorders occaſioned by it ſoon return, and require a repetition of the ſame remedy. In caſes where alkaline ſalts are not immediately at hand, ſoap diſſolved in water will anſwer the ſame purpoſe; or if this alſo ſhould not be inſtantly procurable, chalk, lime, ſpirit of hartſhorn, or magneſia alba, might be uſed with good effect.

Quickſilver is employed in Chili and Peru to extract gold and ſilver, when native, from the earthy matters with which they are mixed. The principle on which this method is founded is the ſtrong mutual attraction betwixt mercury and the precious metals. By reaſon of this the ſmalleſt particles either of gold or ſilver form an amalgam with the mercury, part of which is ſtrained off, and the remainder either ſeparated by diſtillation in iron retorts, or by a kind of diſtillation *per deſcenſum*; putting it in a kind of metallic ſieve over a veſſel of water, to receive the mercury, which is driven down by a fire lighted in a veſſel above the amalgam.

The amalgam with gold ſerves alſo to gild copper or ſilver, ſo that they appear as if made of ſolid gold.—For this purpoſe the pieces are to be well cleaned, and then dipped in a weak aquafortis; then in a nitrous ſolution of quickſilver, which covers them with a kind of ſilvering. After this the amalgam of gold is very equally ſpread over them; which being done, the piece is expoſed to a heat ſufficient to volatilize the quickſilver, and the gold is then left ſtrongly adhering to the metal. The only uſe to which the amalgam of mercury with lead has hitherto been applied, is the luting glaſs veſſels in which ſpecimens of natural hiſtory are to be preſerved in ſpirit of wine. For this it is more proper than any other ſubſtance, having an excellent effect in preventing evaporation. The amalgam of tin is commonly employed in making looking-glaſſes or mirrors. The thin ſheet of tin is laid down on a large flat table of ſtone; a proper quantity of mercury, in which ſome tin has already been diſſolved to prevent it from deſtroying the tin ſheet, is rubbed over with a bunch of cloth like a flat bung, and the glaſs carefully ſlided upon it from one end to the other, in ſuch a manner that the dirty cruſt of the quickſilver is driven off before its edge; and the glaſs is then loaded with weights all over: by inclining gradually the ſtone table, the ſuperfluous mercury is diſcharged, and in a few hours both cohere together. This amalgam is uſed for exciting the electricity of glaſs globes in the common electrical machines, but is ſaid to be inferior in ſtrength to that made with zinc.

Quickſilver heated by itſelf, with acceſs of air, is by degrees converted into a red powder, improperly called *Mercurius precipitatus per ſe*. It conſiſts of the calx of the metal united with the baſis of dephlogiſticated or pure air, which may be expelled from it again by a ſtrong heat; and this was the firſt method by which Dr Prieſtley obtained this kind of air.

Mercury is not altered by the contact of air: It is only obſerved, that it becomes tarniſhed by the particles of duſt which the air depoſits; and from that circumſtance mercury has been called the loadſtone of duſt.—Though all bodies have this property, it ſeems more remarkable in mercury than any other, on account of its great ſplendour; but it is not in the leaſt changed by this circumſtance, nothing more being neceſſary to reſtore it to its original brilliancy than filtration through a piece of ſhamoy leather.

The volatility of mercury prevents it from uniting with earths in the way of fuſion; though M. Fourcroy is of opinion that its red calx, or precipitate *per ſe*, might perhaps fix in glaſſes, and colour them, as is obſerved in the calx of arſenic.

QUICK-MATCH, among artillery men, a kind of combuſtible preparation formed of three cotton ſtrands drawn into length, and dipped in a boiling compoſition of white-wine vinegar, ſaltpetre, and mealed powder. After this immerſion it is taken out hot, and laid in a trough where ſome mealed powder, moiſtened with ſpirits of wine, is thoroughly incorporated into the twiſts of the cotton, by rolling it about therein. Thus prepared, they are taken out ſeparately, and drawn through mealed powder; then hung upon a line and dried, by which they are fit for immediate ſervice.

QUID PRO QUO, in law, *q. d.* "what for what," denotes the giving one thing of value for another; or the mutual conſideration and performance of both parties to a contact.

QUID *pro quo*, or **QUI** *pro quo*, is alſo uſed in phyſic to expreſs a miſtake in the phyſician's bill, where *quid* is wrote for *quo*, i. e. one thing for another; or of the apothecary in reading *quid* for *quo*, and giving the patient the wrong medicine. Hence the term is in the general extended to all blunders or miſtakes committed in medicine, either in the preſcription, the preparation, or application of remedies.

QUIDDITY, QUIDDITAS, a barbarous term uſed in the ſchools for *eſſence*. The name is derived hence, that it is by the eſſence of a thing that it is *tale quid*, ſuch a *quid*, or thing, and not another. Hence what is eſſential to a thing is ſaid to be *quiddative*.

QUIETISTS, a religious ſect, famous towards the cloſe of the laſt century. They were ſo called from a kind of abſolute reſt and inaction, which they ſuppoſed the ſoul to be in when arrived at that ſtate of perfection which they called the *unitive life*; in which ſtate they imagined the ſoul wholly employed in contemplating its God, to whoſe influence it was entirely ſubmiſſive; ſo that he could turn and drive it where and how he would. In this ſtate, the ſoul no longer needs prayers, hymns, &c, being laid, as it were, in the boſom and between the arms of its God, in whom it is in a manner ſwallowed up.

Molinos, a Spaniſh prieſt, is the reputed author of Quietiſm; though the Illuminati in Spain had certainly taught ſomething like it before. The ſentiments of Molinos were contained in a book which he publiſhed at Rome in the year 1681, under the title of the *Spiritual Guide*; for which he was caſt into priſon in 1685, and where he publicly renounced the errors of which he was accuſed. This ſolemn recantation, however, was followed by a ſentence of perpetual impriſonment, and he died in priſon in the year 1696. Molinos had numerous diſciples in Italy, Spain, France, and the Netherlands, One of the principal patrons and propagators of Quietiſm in France was Marie Bouviers de la Mothe Guyon, a woman of faſhion, remarkable for goodneſs of heart and regularity of manners; but of an unſettled temper, and ſubject to be drawn away by the ſeduction of a warm and unbridled fancy. She derived all ideas of religion from the feelings of her own heart, and deſcribed its nature to others as ſhe felt it herſelf. Accordingly, her religious ſentiments made a great noiſe in the year 1687 and they were declared unſound, after accurate inveſtigation, by ſeveral men of eminent piety and learning, and profeſſedly confuted, in the year 1697, by the celebrated Boſſuet. Hence aroſe a controverſy of greater moment between the prelate laſt mentioned and Fenelon archbiſhop of Cambray, who ſeemed diſpoſed to favour the ſyſtem of Guyon, and who in 1697 publiſhed a book containing ſeveral of her tenets. Fenelon's book, by means of Boſſuet, was condemned in the year 1699, by Innocent XII. and the ſentence of condemnation was read by Fenelon himſelf at Cambray, who exhorted the people to reſpect and obey the papal decree, Notwithſtanding this ſeeming acquieſcence, the archbiſhop perſiſted to the end of his days in the ſentiments, which, in obedience to the order of the pope, he retracted and condemned in a public manner.

A ſect ſimilar to this had appeared at Mount Athos in Theſſaly, near the end of the 14th century, called *Heſychaſts*, meaning the ſame with Quietiſts. They were a branch of the myſtics, or thoſe more perfect monks, who, by long and intenſe contemplation, endeavoured to arrive at a tranquillity of mind free from every degree of tumult and perturbation. In conformity to an ancient opinion of their principal doctors (who thought there was a celeſtial light concealed in the deepeſt retirements of the mind), they uſed to ſit every day, during a certain ſpace of time, in a ſolitary corner, with their eyes eagerly and immovably fixed upon the middle regions of the belly or navel; and boaſted, that while they remained in this poſture, they found, in effect, a divine light beaming forth from their ſoul, which diffuſed through their hearts inexpreſſible ſenſations of pleaſure and delight. To ſuch as inquired what kind of light this was, they replied, by way of illuſtration, that it was the glory of God, the ſame celeſtial radiance that ſurrounded Chriſt during his transfiguration on the Mount. Barlaam, a monk of Calabria, from whom the Barlaamites derived their denomination, ſtyled the monks who adhered to this inſtitution *Maſſalians* and *Euchites*; and he gave them alſo the new name of *Umbilicani*. Gregory Palamas, archbiſhop of Theſſalonica, defended their cauſe againſt Barlaam, who was condemned in a council held at Conſtantinople in the year 1341.—See *Fenelon's Max. des Saints*.

The Mahometans ſeem to be no ſtrangers to quietiſm. They expound a paſſage in the 17th chapter of the Koran, viz. "O thou ſoul which art at reſt, return unto thy Lord, &c." of a ſoul which, having, by purſuing the concatenation of natural cauſes, raiſed itſelf to the knowledge of that being which produced them, and exiſts of neceſſity, reſts fully contented, and acquieſces in the knowledge, &c. of him, and in the contemplation of his perfection.

QUILLET (Claude), an eminent Latin poet of the 17th century, was born at Chinon, in Touraine, and practiſed phyſic there with reputation: but having declared againſt the pretended poſſeſſion of the nuns of Loudun, in a manuſcript treatiſe, the original of which was depoſited in the library of the Sorbonne, he was obliged to retire into Italy, where he became ſecretary to the marſhal d'Eſtrees, the French ambaſſador at Rome. In 1655 Quillet having publiſhed in Holland a Latin poem, entitled *Callipædia*, under the name of *Galvidius Lætus*, he there inſerted ſome verſes againſt the cardinal Mazarine and his family; but that cardinal making him ſome gentle reproaches, he retrenched what related to the cardinal in another edition, and dedicated it to him, Mazarine having, before it was printed, given him an abbey. He died in 1661, aged 59, after having given Menage all his writings, and 500 crowns to pay the expence of printing them; but the abbé took the money and papers, and publiſhed none of them. His *Callipædia*, or the art of getting beautiful children, has been tranſlated into Engliſh verſe.

QUILLS, the large feathers taken out of the end of the wing of a gooſe, crow, &c. They are denominated from the order in which they are fixed in the wing; the ſecond and third quills being the beſt for writing, as they have the largeſt and roundeſt barrels. Crow-quills are chiefly uſed for drawing. In order to harden a quill that is ſoft, thruſt the barrel into hot aſhes, ſtirring it till it is ſoft, and then taking it out, preſs it almoſt flat upon your knee with the back of a penknife, and afterwards reduce it to a roundneſs with your fingers. If you have a number to harden, ſet water and alum over the fire, and while it is boiling put in a handful of quills, the barrels only, for a minute, and then lay them by.

QUIN (James), a celebrated performer on the Engliſh ſtage, was born at London in 1693. He was intended for the bar; but preferring Shakeſpeare to the ſtatutes at large, he on the death of his father, when it was neceſſary for him to do ſomething for himſelf, appeared on the ſtage at Drury-lane. In 1720, he firſt diſplayed his comic powers in the character of Falſtaff, and ſoon after appeared to as great advantage in Sir John Brute; but it was upon Booth's quitting the ſtage that Quin appeared to full advantage, in the part of Cato. He continued a favourite performer until the year 1748, when, on ſome diſguſt between him and Mr Rich the manager, he retired to Bath, and only came up annually to act for the benefit of his friend Ryan; until the loſs of two front teeth ſpoiled his utterance for the ſtage. While Mr Quin continued upon the ſtage, he conſtantly kept company with the greateſt geniuſes of the age. He was well known to Pope and Swift; and the earl of Cheſterfield frequently invited him to his table: but there was none for whom he entertained a higher eſteem than for the ingenious Mr Thomſon, to whom he made himſelf known by an act of generoſity that does the greateſt honour to his character; and for an account of which ſee our life of THOMSON. Mr Quin's judgment in the Engliſh language recommended him to his royal highneſs Frederick prince of Wales, who appointed him to inſtruct his children in ſpeaking and reading with a graceful propriety; and Quin being informed of the elegant manner in which his preſent majeſty delivered his firſt gracious ſpeech from the throne, he cried out in a kind of ecſtacy, "Ay—I taught the boy to ſpeak!" Nor did his majeſty forget his old tutor; for, ſoon after his acceſſion to the throne, he gave orders, without any application being made to him, that a genteel penſion ſhould be paid to Mr Quin during his life. Mr Quin, indeed, was not in abſolute need of this royal benefaction; for as he was never married, and had none but diſtant relations, he ſunk 2000 l. which was half his fortune, in an annuity, for which he obtained 200 l. a-year; and with about 2000 l. more in the funds, lived in a decent manner during the latter part of his life at Bath, from whence he carried on a regular correſpondence with Mr Garrick, and generally paid a viſit to his friends in the metropolis once a-year, when he conſtantly paſſed a week or two at Mr Garrick's villa at Hampton. He died of a fever in 1766.

QUINARIUS, was a ſmall Roman coin equal to half the denarius, and conſequently worth about three pence three farthings ſterling. See MONEY.

It was called *quinarius*, becauſe it contained the value of five aſſes, in the ſame manner as the denarius was named from its containing ten.

QUINAUT (Philip), a celebrated French poet, born of a good family at Paris in 1635. He cultivated poetry from his infancy, and 16 dramatic pieces of his were acted between the year 1653 and 1666. In the mean time, Quinaut was not ſo much devoted to poetry but that he applied himſelf to the ſtudy of the law; and made his fortune by marrying the widow of a rich merchant to whom he had been uſeful in his profeſſion. Quinaut afterwards turned his attention to the compoſing of operas, which were ſet to muſic by the famous Lully; and Lully was charmed with a poet whoſe verſes were not too nervous to yield to the capricious airs of muſic. He died in 1688, after having enjoyed a handſome penſion from Louis XIV. for many years: and we are told he was extremely penitent in his laſt illneſs for all thoſe of his compoſitions which tended to inſpire love and pleaſure.

QUINCE, in botany. See CYDONIA.

QUINCUNX, in Roman antiquity, denotes any thing that conſiſts of five twelfths of another; but particularly of the *as*.

QUINCUNX *Order*, in gardening, is a plantation of trees, diſpoſed originally in a ſquare conſiſting of five trees, one at each corner, and a fifth in the middle; which diſpoſition, repeated again and again, forms a regular grove, wood, or wilderneſs.

QUINDECAGON, in geometry, a plain figure with 15 ſides and 15 angles.

QUINDECEMVIRI, in Roman antiquity, a college of 15 magiſtrates, whoſe buſineſs it was to preſide over the ſacrifices. They were alſo the interpreters of the Sybil's books; which, however, they never conſulted but by an expreſs order of the ſenate.

QUINQUAGENARIUS, in Roman antquity, an officer who had the command of 50 men.

QUINQUAGESIMA SUNDAY, Shrove Sunday, ſo called as being about the 50th day before Eaſter.

QUINQUATRIA, or QUINQUATRUS, was a feſtival kept at Rome in honour of Minerva, which began on the 18th of March, or as others will have it on the 19th, and laſted five days. On the firſt day they offered ſacrifices and oblations without the effuſion of blood; the ſecond, third, and fourth, were ſpent in ſhows of gladiators; and on the fifth day they went in proceſſion through the city. Scholars had a vacation during the ſolemnity, and preſented their maſters at this time with a gift or fee, called *Minerval*. Boys and girls uſed now to pray to the goddeſs Minerva for wiſdom and learning, of which ſhe had the patronage. Plays were acted, and diſputations held, at this feaſt, on ſubjects of polite literature. The quinquatria were ſo called, becauſe they laſted for five days. There ſeems to be a ſtrong reſemblance betwixt this feſtival and the panathenæa of the Greeks.

QUINQUENNALIS, in Roman antiquity, a magiſtrate in the colonies and municipal cities of that empire, who had much the ſame office as the ædile at Rome.

QUINQUEREMIS, in the naval architecture of the ancients, a name given to a galley which had five rows of oars. They divided their veſſels in general into *monocrota* and *polycrota**. The former had only one tire of rowers: the latter had ſeveral tires of them, from two or three up to 20, 30, or even 40; for ſuch a veſſel we have an account of in the time of Philopater, which required no leſs than 4000 men to row it.

Meibom has taken off from the imaginary improbability of there ever having been ſuch a veſſel, by reducing the enormous height ſuppoſed neceſſary for ſuch a number of rows of oars and men to work them, by finding a better way of placing the men than others had thought of. The quinqueremes of the ancients had 420 men in each; 300 of which were rowers, and the reſt ſoldiers. The Roman fleet at Meſſina conſiſted of 330 of theſe ſhips; and the Carthaginian, at Lilybœum, of 350 of the ſame ſize. Each veſſel was 150 feet long. Thus 130,000 men were contained in the one, and 150,000 in the other, with the apparatus and proviſions neceſſary for ſuch expeditions as they were intended for. This gives ſo grand an idea of the ancient naval armaments, that ſome have queſtioned the truth of the hiſtory: but we find it related by Polybius, an hiſtorian too authentic to be queſtioned, and who expreſſes his wonder at it while he relates it.

QUINQUEVIRI, in Roman antiquity, an order of five prieſts, peculiarly appointed for the ſacrifices to the dead, or celebrating the rites of Erebus.

QUIQUINA. See CINCHONA.

QUINSY, or QUINZY. See MEDICINE, nº 177—183.

QUINTEN, a town of France, in Bretagne, with the title of a duchy, and a handſome caſtle. It is ſeated in a valley near the river Guy, and near a large foreſt of the ſame name, eight miles ſouth of St Brieux, and 200 weſt of Paris. W. Long. 2. 40. N. Lat. 48. 26.

QUINTESSENCE, in chemiſtry, a preparation conſiſting of the eſſential oil of ſome vegetable ſubſtance, mixed and incorporated with ſpirit of wine.

QUINTESSENCE, in alchemy, is a myſterious term, ſignifying the fifth or laſt and higheſt eſſence of power in a natural body.

QUINTILE, in aſtronomy, an aſpect of the planets when they are 72 degrees diſtant from one another, or a fifth part of the zodiac.

QUINTILIANUS (Marcus Fabius), a celebrated Latin orator, and the moſt judicious critic of his time, was a native of Calagurris, or Calahorra, in Spain; and was the diſciple of Domitius Afer, who died in the year 59. He taught rhetoric at Rome for 20 years with great applauſe: and not only laid down rules for ſpeaking, but exhibited his eloquence at the bar. Some authors imagine, but with little foundation, that he arrived to the conſulſhip; but it is more certain that he was preceptor to the grandſons of the emperor Domitian's ſiſter. There is ſtill extant his excellent work, intitled, *Inſtitutiones Oratoriæ*, which is a treatiſe of rhetoric in 12 books; where his precepts, judgment, and taſte, are juſtly admired. Theſe inſtitutions were found entire by Poggius, in an old tower of the abbey of St Gal, and not in a grocer's ſhop in Germany as ſome authors have imagined. There is alſo attributed to Quintilian a dialogue *De cauſis corruptæ eloquentiæ*; but it is more commonly aſcribed to Tacitus. The beſt editions of Quintilian's works are thoſe of Mr Obreight, publiſhed at Straſburg in 2 vols 4to, in 1698, and of M. Capperonier, in folio. There is an Engliſh tranſlation by Mr Guthrie.

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* See Polycrota.

Quintilian had a ſon of the ſame name, on whom he beſtows great praiſes. This ſon ought not to be confounded with Quintilian the father, or rather the grandfather, of him who is the ſubject of this article, and who wrote 145 declamations. Ugolin of Parma publiſhed the firſt 136 in the 15th century; the nine others were publiſhed in 1563 by Peter Ayrault, and afterwards by Peter Pithou in 1580. There have alſo been 19 other declamations printed under the name of Quintilian the Orator; but, in the opinion of Voſſius, they were written neither by that orator nor his grandfather.

QUINTILIANS, a ſect of ancient heretics, thus called from their propheteſs Quintilia. In this ſect the women were admitted to perform the ſacerdotal and epiſcopal functions. They attributed extraordinary gifts to Eve for having firſt eaten of the tree of knowledge; told great things of Mary the ſiſter of Moſes, as having been a propheteſs, &c. They added, that Philip the deacon had four daughters, who were all propheteſſes, and were of their ſect. In theſe aſſemblies it was uſual to ſee the virgins entering in white robes, perſonating propheteſſes.

QUINTIN MATSYS, alſo called the *Farrier of Antwerp*, famous for being tranſformed, by the force of love, from a blackſmith to a painter. He had followed the trade of a blackſmith and farrier near twenty years; when falling in love with a painter's daughter who was very handſome, and diſliked nothing but his trade, he quitted it, and betook himſelf to painting, in which he made a very uncommon progreſs. He was a diligent and careful imitator of ordinary life, and ſucceeded better in repreſenting the defects than the beauties of nature. Some hiſtorical performances of this maſter deſerve commendation, particularly a Deſcent from the Croſs, in the Cathedral at Antwerp: but his beſt known picture is that of the two Miſers in the gallery at Windſor. He died in 1529.

QUINTINIE (John de la), a celebrated French gardener, born at Poictiers in 1626. He was brought up to the law; and acquitted himſelf ſo well at the bar as to acquire the eſteem of the chief magiſtrate. M. Tamboneau, preſident of the chamber of accounts, engaged him to undertake the preceptorſhip of his only ſon, which Quintinie executed entirely to his ſatisfaction; applying his leiſure hours to the ſtudy of writers on agriculture, ancient and modern, to which he had a ſtrong inclination. He gained new lights by attending his pupil to Italy; for all the gardens about Rome being open to him, he failed not to add practice to his theory. On his return to Paris, M. Tamboneau gave up the management of his garden entirely to him; and Quintinie applied ſo cloſely to it, that he became famous all over France. Louis XIV. erected a new office purpoſely for him, that of director of the royal fruit and kitchen gardens; and theſe gardens, while he lived, were the admiration of the curious. He lived to a good old age, though we learn not the time of his death; his Directions for the Management of Fruit and Kitchen Gardens are eſteemed all over Europe.

QUINTUS CALABER, a Greek poet, who wrote a large Supplement to Homer's Iliad, in 14 books, in which a relation is given of the Trojan war from the death of Hector to the deſtruction of Troy. It is conjectured, from his ſtyle and manner, that he lived in the fifth century. Nothing certain can be collected either concerning his perſon or country. His poem was firſt made known by Cardinal Beſſarion, who diſcovered it in St Nicolas's church, near Otranto in Calabria; from whence the author was named *Quintus Calaber*. It was firſt publiſhed at Venice by Aldus, but it is not ſaid in what year.

QUINTUS CURTIUS. See CURTIUS.

QUINZY, QUINSEY, or *Angina Pectoris*. See MEDICINE, n° 403.

QUIRE OF PAPER, the quantity of 24 or 25 ſheets.

QUIRINALIA, in antiquity, a feaſt celebrated among the Romans in honour of Romulus.

QUIRITES, in Roman antiquity. In conſequence of the agreement entered into by Romulus and Tatius king of the Sabines, Rome was to retain its name, taken from Romulus; and the people were to be called *Quirites*, from Cures, the principal town of the Sabines, a name uſed in all public addreſſes to the Roman people.——Dion. Hal. ſays, that each particular citizen was to be called *Romanus*, and the collective body of them *Quirites*; yet it appears by this ancient form of words uſed at funerals, *Ollus Quiris letho datus eſt*, that each private citizen was alſo called *Quiris*.

The origin of the word *Quirites*, which was at firſt peculiar to the Sabines, and became, in Romulus's time, the general name of the inhabitants of Rome, has been much ſought for; and the moſt propable account antiquity gives us of it, is this: The word *Quiris*, according to Plutarch and ſome others, ſignified, in the Sabine language, both "a dart," and "a warlike deity armed with a dart." It is uncertain whether the god gave name to the dart, or the dart to the god. But be that as it will, this *Quiris*, or *Quirinus*, was either Mars or ſome other god of war; and the worſhip of *Quiris* continued in Rome all Romulus's reign: but after his death he was honoured with the name *Quirinus*, and took the place of the god *Quiris*.

QUIRK, in a general ſenſe, denotes a ſubtilty or artful diſtinction.

QUIRK, in building, a piece of ground taken out of any regular ground-plot, or floor: thus, if the ground-plot were oblong or ſquare, a piece taken out of a corner to make a court or yard, &c. is called a *quirk*.

QUISQUALIS, in botany: A genus of the monogynia order, belonging to the decandria claſs of plants; and in the natural method ranking under the 31ſt order, *Vepreculæ*. The calyx is quinquefid and filiform; the petals five; the fruit is a quinqueangular plum. There is only one ſpecies, viz. INDICA.

QUITO, a town of South America, in Peru (ſee PERU, p. 213.), ſeated between two chains of high mountains called *Cordillera de los Andes*, on much higher ground than the reſt of habitable Peru. It is 300 yards higher than the level of the ſea according to the exacteſt obſervations. The town is 1600 yards long and 1200 broad, and is the ſeat of a biſhop. It contains about 35,000 inhabitants, one third of whom are originally Spaniards. Among the inhabitants are ſome perſons of high rank and diſtinction, deſcended either from the original conquerors, or perſons who at different times came from Spain inveſted with ſome lucrative poſt. The number of theſe, however, is but ſmall. The commonalty, beſides Spaniards, conſiſt of Meſtizos, Indians, and Negroes; but the laſt are not proportionally numerous. Merchandizes and commodities of all ſorts are extremely dear, partly on account of the difficulty of bringing them.

There are ſeveral religious communities at Quito, and two colleges or univerſities governed by Jeſuits and Dominicans.

The principal courts held at Quito are that of the royal audience, which conſiſts of a preſident, who is governor of the province with regard to law affairs; four auditors, who are at the ſame time civil and criminal judges; a royal fiſcal, who, beſides the cauſes brought before the audience, takes cognizance of every thing relating to the revenue; and an officer ſtyled the *protector of the Indians*, who ſolicits for them, and when they are injured pleads in their defence. The next is the treaſury, the chief officers of which are an accountant, a treaſurer, and a royal fiſcal. The tribunal of the Croiſade, which has a commiſſary, who is generally ſome dignitary of the church, and a treaſurer. There is alſo a treaſury for the effects of perſons deceaſed: an inſtitution eſtabliſhed all over the Indies, for receiving the goods of thoſe whoſe lawful heirs are in Spain, in order to ſecure them from thoſe accidents to which they might be liable in private hands. There is likewiſe a commiſſary of the inquiſition, with an alguazil-major and familiars, appointed by the inquiſition at Lima. The corporation conſiſts of a corregidor, two ordinary alcaldes, choſen annually, and regidores. The latter ſuperintend the election of the alcaldes, which is attended with no ſmall diſturbance, the people being divided into two parties, the Creoles and Europeans.

QUITTER-bone, in farriery. See there, § xl. 4.

QUIT-rent (*quietus redditus*, i. e. "quiet rent,") is a certain ſmall rent payable by the tenants of manors, in token of ſubjection, and by which the tenant goes quiet and free. In ancient records it is called *white rent*, becauſe paid in ſilver money, to diſtinguiſh it from rent-corn, &c.

QUOIN, or Coin, on board a ſhip, a wedge faſtened on the deck cloſe to the breach of the carriage of a gun, to keep it firm up to the ſhip's ſide. Cantic quoins are ſhort three-legged quoins put between caſks to keep them ſteady.

Quoins, in architecture, denote the corners of brick or ſtone walls. The word is particularly uſed for the ſtones in the corners of brick buildings. When theſe ſtand out beyond the brick-work, their edges being chamfred off, they are called *ruſtic quoins*.

QUOTIDIAN, any thing which happens every day. Hence, when the paroxyſms of an ague recur every day, it is called a *quotidian ague*. See Medicine, nº 161—164.

QUOTIDIANA deceptiva. See Medicine, nº 150.

QUOAD hoc, is a term uſed in the pleadings and arguments of lawyers; being as much as to ſay, As to this thing the law is ſo and ſo.

QUORUM, a word frequently mentioned in the ſtatutes, and in commiſſions both of juſtices of the peace and others. It is thus called from the words of the commiſſion, *quorum* A. B. *unum eſſe volumus*. For an example, where a commiſſion is directed to ſeven perſons, or to any three of them, whereof A. B. and C. D. are to be two; in this caſe, they are ſaid to be of the quorum, becauſe the reſt cannot proceed without them: ſo a juſtice of the peace and quorum is one without whom the reſt of the juſtices in ſome caſes cannot proceed.

QUOTIENT, in arithmetic, the number reſulting from the diviſion of a greater number by a ſmaller; and which ſhows how often the ſmaller is contained in the greater, or how often the diviſor is contained in the divided. The word is formed from the Latin *quoties*; *q. d.* How often is ſuch a number contained in ſuch another?

In diviſion, as the diviſor is to the dividend, ſo is unity to the quotient.—Thus the quotient of 12 divided by 3 is 4; which is thus diſpoſed, 3) 12 (4 quotient. See Arithmetic.

R.

R, or *r*, a liquid conſonant, being the 17th letter of our alphabet. Its ſound is formed by a guttural extruſion of the breath vibrated through the mouth, with a ſort of quivering motion of the tongue drawn from the teeth, and canulated with the tip a little elevated towards the palate. In Greek words it is frequently aſpirated with an *h* after it, as in *rhapſody*, *rhetoric*, &c. otherwiſe it is always followed by a vowel at the beginning of words and ſyllables.

In the notes of the ancients, R. or RO. ſignifies *Roma*; R. C. *Romana civitas*; R. G. C. *rei gerendæ cauſa*; R. F. E. D. *recte factum et dictum*; R. G. F. *regis filius*; R. P. *res publica*, or *Romani principes*; and R. R. R. F. F. F. [*res Romana ruet ferro, fame, flamma.*

Uſed as a numeral, R anciently ſtood for 80; and with a daſh over it, thus $\overline{R}$, for 80,000; but the Greek *r*, $\overset{\prime}{\rho}$, with a ſmall mark over it, ſignified 100; with the ſame mark under it, it denoted 1000 × 100; thus $\underset{\prime}{\rho}$ ſignified 100,000. In the Hebrew numeration ר denoted 200: and with two horizontal points over it 1000 × 200; thus ר̈ = 200,000.

In the preſcriptions of phyſicians, R or ℞ ſtands for *recipe*, *i. e.* "take."

RAAB, a town of Lower Hungary, capital of Javerin, with a caſtle and a biſhop's ſee. It is a ſtrong frontier bulwark againſt the Turks, and has two bridges, one over a double ditch, and another that leads towards Alba Regalis. The ſurrounding country is plain, and there is nothing that ſeems to command it but a ſmall hill at ſome diſtance, which is undermined and may be blown up. It was taken by Amurath III. with the loſs of 20,000 men; but was ſurpriſed ſoon after by Count Palfi, who killed all the Turks that were found therein. It is ſeated at the confluence of the rivers Rab and Rabnitz, not far from the Danube, 32 miles weſt of Gran, and 55 ſouth-eaſt of Vienna. E. Long. 17. 25. N. Lat. 47. 48.

RABAC, a ſmall port on the Arabian coaſt of the Red Sea, in N. Lat. 22° 35′ 40″ by Mr Bruce's account. The entry to the harbour is from the E. N. E. and is about a quarter of a mile broad. The port extends about two miles in length to the eaſtward. The mountains are about three leagues to the north, and the town about four miles north by eaſt from the entrance to the harbour. The water is good, and all ſhips may be ſupplied here from the wells which are in the neighbourhood of the town. The country is bare and uncultivated; but from the appearance of it, and the freſhneſs of the water, Mr Bruce ſuppoſes that it ſometimes rains among the mountains here, which is the more probable as it is conſiderably within the tropic.

RABAT, a large and handſome ſea-port town of Africa, in the kingdom of Fez and province of Tremeſen. It has fine moſques and handſome palaces, and is ſeated at the mouth of the river Burrigrig, almoſt in the mid-way between Fez and Tangier. W. Long. 5. 28. N. Lat. 34. 40.

Rabat, together with Sallee, which is oppoſite to it, was formerly famous for fitting out piratical veſſels; but the late emperor Sidi Mahomet ſubdued them both, and annexed them to the empire; ſince which time the harbour of Rabat has been ſo filled with the ſand waſhed in by the ſea as to render it unfit to carry on ſuch piracies in future.

The town of Rabat, whoſe walls incloſe a large ſpace of ground, is defended on the ſea-ſide by three forts tolerably well finiſhed, which were erected ſome little time ago by an Engliſh renegado, and furniſhed with guns from Gibraltar. The houſes in general are good, and many of the inhabitants are wealthy. The Jews, who are very numerous in this place, are generally in better circumſtances than thoſe of Larache or Tangier, and their women are extremely beautiful.

The caſtle, which is very extenſive, contains a ſtrong building, formerly uſed by the late emperor as his principal treaſury, and a noble terrace, which commands an extenſive proſpect of the town of Sallee, the ocean, and all the neighbouring country. There are alſo the ruins of another caſtle, which is ſaid to have been built by Jacob Almonzor, one of their former emperors, and of which at preſent very little remains but its walls, containing within them ſome very ſtrong magazines for powder and naval ſtores. On the outſide of theſe walls is a very high and ſquare tower, handſomely built of cut ſtone, and called the tower of *Haſſen*. From the workmanſhip of this tower, contraſted with the other buildings, a very accurate idea may be formed how greatly the Moors have degenerated from their former ſplendour and taſte for architecture.

RABBETTING, in carpentry, the planning or cutting of channels or grooves in boards, &c.

In ſhip-carpentry, it ſignifies the letting in of the planks of the ſhip into the keel; which, in the rake and run of a ſhip, is hollowed away, that the planks may join the cloſer.

RABBI, or RABBINS, a title which the Phariſees and doctors of the law among the Jews aſſumed, and literally ſignifies *maſters* or *excellents*.

There were ſeveral gradations before they arrived at the dignity of a rabbin; which was not conferred till they had acquired the profoundeſt knowledge of the law and the traditions. It does not, however, appear that there was any fixed age or previous examination neceſſary; but when a man had diſtinguiſhed himſelf by his ſkill in the written and oral law, and paſſed through the ſubordinate degrees, he was ſaluted a rabbin by the public voice.

Among the modern Jews, for near 700 years paſt, the learned men retain no other title than that of *rabbi*, or *rabbins*; they have great reſpect paid them, have the firſt places or ſeats in their ſynagogues, determine all matters of controverſy, and frequently pronounce upon civil affairs; they have even power to excommunicate the diſobedient.

RABBINISTS, among the modern Jews, an appellation given to the doctrine of the rabbins concerning traditions, in oppoſition to the Caraites; who reject all traditions. See CARAITE.

RABELAIS (Francis), a French writer famous for his facetiouſneſs, was born at Chinon in Touraine about the year 1483. He was firſt a Franciſcan friar; but quitting his religious habit ſtudied phyſic at Montpelier, where he took his doctor's degree. It is ſaid, that the chancellor du Pratt having aboliſhed the privileges of the faculty of phyſic at Montpelier by a decree of the parliament, Rabelais had the addreſs to make him revoke what he had done; and that thoſe who were made doctors of that univerſity wore Rabelais's robe, which is there held in great veneration. Some time after, he came to Rome, in quality of phyſician in ordinary to Cardinal John du Bellay archbiſhop of Paris. Rabelais is ſaid to have uſed the freedom to jeer Pope Paul III. to his face. He had quitted his religious connections for the ſake of leading a life more agreeable to his taſte; but renewed them on a ſecond journey to Rome, when he obtained, in 1536, a brief to qualify him for holding eccleſiaſtical benefices; and, by the intereſt of his friend Cardinal John du Bellay, he was received as a ſecular canon in the abbey of St Maur near Paris. His profound knowledge in phyſic rendered him doubly uſeful; he being as ready, and at leaſt as well qualified, to preſcribe for the body as for the ſoul: but as he was a man of wit and humour, many ridiculous things are laid to his charge, of which he was quite innocent. He publiſhed ſeveral things; but his chief performance is a ſtrange incoherent romance, called the *Hiſtory of Gargantua and Pantagruel*, being a ſatire upon prieſts, popes, fools, and knaves of all kinds. This work contains a wild, irregular profuſion of wit, learning, obſcenity, low conceits, and arrant nonſenſe; hence the ſhrewdneſs of his ſatire, in ſome places where he is to be underſtood, gains him credit for thoſe where no meaning is diſcoverable. Some alluſions may undoubtedly have been ſo temporary and local as to be now quite loſt: but it is too much to conclude thus in favour of every unintelligible rhapſody; for we were not without Engliſh writers of great talents, whoſe ſportive geniuſes have betrayed them into puerilities, no leſs incoherent at the times of writing than thoſe of Rabelais appear above two centuries after. He died about 1553.

RABBIT, in zoology. See Lepus.

The buck rabbits, like our boar cats, will kill the young ones if they can get at them; and the does in the warrens prevent this, by covering their ſtocks, or neſts, with gravel or earth, which they cloſe ſo artificially up with the hinder part of their bodies, that it is hard to find them out. They never ſuckle their young ones at any other time than early in the morning and late at night; and always, for eight or ten days, cloſe up the hole at the mouth of the neſt, in this careful manner when they go out. After this they begin to leave a ſmall opening, which they increaſe by degrees; till at length, when they are about three weeks old, the mouth of the hole is left wholly open that they may go out; for they are at that time grown big enough to take care of themſelves, and to feed on graſs.

People who keep rabbits tame for profit, breed them in hutches; but theſe muſt be kept very neat and clean, elſe they will be always ſubject to diſeaſes. Care muſt be taken alſo to keep the bucks and does apart till the latter have juſt kindled; then they are to be turned to the bucks again, and to remain with them till they ſhun and run from them.

The general direction for the chooſing of tame rabbits is, to pick the largeſt and faireſt; but the breeder ſhould remember that the ſkins of the ſilver-haired ones ſell better than any other. The food of the tame rabbits may be colewort and cabbage-leaves, carrots, parſneps, apple-rinds, green corn, and vetches, in the time of the year; alſo vine-leaves, graſs, fruits, oats, and oatmeal, milk-thiſtles, ſow-thiſtles, and the like: but with theſe moiſt foods they muſt always have a proportionable quantity of the dry foods, as hay, bread, oats, bran, and the like, otherwiſe they will grow pot-bellied, and die. Bran and grains mixed together have been alſo found to be very good food. In winter they will eat hay, oats, and chaff, and theſe may be given them three times a-day; but when they eat green things, it muſt be obſerved that they are not to drink at all, for it would throw them into a dropſy. At all other times a very little drink ſerves their turn, but that muſt always be freſh. When any green herbs or graſs are cut for their food, care muſt be taken that there be no hemlock among it; for though they will eat this greedily among other things when offered to them, yet it is ſudden poiſon to them.

Rabbits are ſubject to two principal infirmities. Firſt, the rot, which is cauſed by giving them too large a quantity of greens, or from giving them freſh gathered with the dew or rain hanging in drops upon them. It is over-moiſture that always cauſes this diſeaſe. The greens therefore are always to be given dry; and a ſufficient quantity of hay, or other dry food, intermixed with them, to take up the abundant moiſture of their juices. On this account the very beſt food that can be given them, is the ſhorteſt and ſweeteſt hay that can be got, of which one load will ſerve 200 couples a year; and out of this ſtock of 200, 200 may be eat in the family, 200 ſold to the markets, and a ſufficient number kept in caſe of accidents.

The other general diſeaſe of theſe creatures is a ſort of madneſs: this may be known by their wallowing and tumbling about with their heels upwards, and hopping in an odd manner into their boxes. This diſtemper is ſuppoſed to be owing to the rankneſs of their feeding; and the general cure is the keeping them low, and giving them the prickly herb called *tare-thiſtle* to eat.

The general computation of males and females is, that one buck-rabbit will ſerve for nine does: ſome allow 10 to one buck; but thoſe who go beyond this always ſuffer for it in their breed.

The wild rabbits are either to be taken by ſmall cur-dogs, or by ſpaniels bred up to the ſport; and the places of hunting thoſe who ſtraggle from their burrows, is under cloſe hedges or buſhes, or among corn-fields and freſh paſtures. The owners uſe to courſe them with ſmall grey-hounds; and though they are ſeldom killed this way, yet they are driven back to their burrows, and are prevented from being a prey to others. The common method is by nets called *purſe nets*, and ferrets. The ferret is ſent into the hole to fetch them out; and the purſe-net being ſpread over the hole, takes them as they come out. The ferrets' mouths muſt be muffled, and then the rabbit gets no harm. For the more certain taking of them, it may not be improper to pitch up a hay-net or two, at a ſmall diſtance from the burrows that are intended to be hunted: thus very few of the number that are attempted will eſcape.

Some who have not ferrets ſmoke the rabbits out of their holes with burning brimſtone and orpiment. This certainly brings them out into the nets: but then it is a very troubleſome and offenſive method; and is very detrimental to the place, as no rabbit will for a long time afterwards come near the burrows which have been fumed with thoſe ſtinking ingredients.

The teſticle of a rabbit is a very good object for examining the ſtructure of this part of generation in animals. The whole ſubſtance of the teſticle in this animal is made up of veſſels, which lie round folds in the manner of the ſmaller inteſtines: but then both ends of each roll meet at their inſertion, which ſeems to be made into the *ductus nervoſus*; and every one of theſe little rolls is curiouſly embroidered with other veſſels, which, from their red colour, appear to be arteries and veins. The ſeveral little rolls lie in ranges, diſpoſed with an uniformity which is very agreeable to the eye. Every one of theſe rolls is not a ſingle and entire tube, but each conſiſts of ſeveral tubes, beſide the veins and arteries which embroider it. This is beſt diſtinguiſhed by the cutting one of the rolls tranſverſely, and then examining the cut end with a glaſs, which will appear to be made up of the cut and open ends of four, five, or more parallel tubes, which together form the roll, or ſingle tube, as it appears to the eye, being all wrapped up in one common and very thin membrane. Theſe are ſo tender that they cannot be explicated and viewed diſtinct, as De Graaf tells us thoſe of the teſticles of a rat and of ſome other animals may. Theſe, however, as well as the others, are only made up of a congeries of veſſels, and the liquors, which are their contents, without any intermediate ſubſtance, or any thing of that parenchyma which many authors have talked of. The teſticles of a bull have the greateſt appearance of a fleſhy texture of thoſe of any known animal; yet even theſe afford no particle of parenchyma, or fleſh, when examined by glaſſes in any ſort of preparation, whether boiled, raw, ſoaked in ſpirits, or in whatever other ſtate.

The teſticles of various animals are very variouſly compoſed, but all in this general manner of veſſels variouſly rolled and folded together : and even the human teſticles are of the ſame ſort ; being compoſed ſolely of rolls of veſſels, without any intermediate ſubſtance, be it called by whatever name, but only conſiſting of veſſels and their liquors.

RABIRIUS (C.) a Roman knight, who lent an immenſe ſum of money to Ptolemy Auletes king of Egypt. The monarch afterwards not only refuſed to repay him, but even confined him, and endangered his life. Rabirius eſcaped from Egypt with difficulty ; but at his return to Rome he was accuſed by the ſenate of having lent money to an African prince for unlawful purpoſes. He was ably defended by Cicero, and acquitted with difficulty.—There was a Latin poet of the ſame name in the age of Auguſtus. He wrote a poem on the victory which the emperor had gained over Antony at Actium. Seneca has compared him to Virgil for elegance and majeſty ; but Quintilian is not ſo favourable to his poetry.—And there was an architect in the reign of Domitian, called *Rabirius*. He built a celebrated palace for the emperor, of which the ruins are ſtill ſeen at Rome.

RACCOON. See URSUS.

RACE, in general, ſignifies running with others in order to obtain a prize, either on foot, or by riding on horſeback, in chariots, &c.

The race was one of the exerciſes among the ancient Grecian games, which was performed in a courſe containing 125 paces ; and thoſe who contended in theſe foot-races were frequently clothed in armour. Chariot and horſe races alſo made a part of theſe ancient games.

Races were known in England in very early times. Fitz-Stephen, who wrote in the days of Henry II. mentions the great delight that the citizens of London took in the diverſion. But by his words, it appears not to have been deſigned for the purpoſes of gaming, but merely to have ſprung from a generous emulation of ſhowing a ſuperior ſkill in horſemanſhip.

Races appear to have been in vogue in the reign of Queen Elizabeth, and to have been carried to ſuch exceſs at to injure the fortunes of the nobility. The famous George earl of Cumberland is recorded to have waſted more of his eſtate than any of his anceſtors ; and chiefly by his extreme love to horſe-races, tiltings, and other expenſive diverſions. It is probable that the parſimonious queen did not approve of it ; for races are not among the diverſions exhibited at Kennelworth by her favourite Leiceſter. In the following reign, were places allotted for the ſport : Croydon in the ſouth, and Garterly in Yorkſhire, were celebrated courſes. Camden alſo ſays, that in 1607 there were races near York, and the prize was a little golden bell. See RACING.

RACE, in genealogy, a lineage or extraction continued from father to ſon. See DESCENT.

RACINE (John), of the French academy, treaſurer of France in the generality of Moulins, and ſecretary to his majeſty, was born at Ferre-Milon in 1639. He had a fine genius for the *Belles Lettres*, and became one of the firſt poets of the age. He produced his *Thebaide* when but very young ; and afterwards other pieces, which met with great ſucceſs, though they appeared when Corneille was in his higheſt reputation. In his career, however, he did not fail to meet with all that oppoſition which envy and cabal are ever ready to ſet up againſt a ſuperior genius. It was partly owing to a chagrin from this circumſtance that he took a reſolution to quit the theatre forever ; although his genius was ſtill in full vigour, being not more than 38 years of age. But he had alſo imbibed in his infancy a deep ſenſe of religion ; and this, though it had been ſmothered for a while by his connections with the theatre, and particularly with the famous actreſs Champmelie, whom he greatly loved, and by whom he had a ſon, now at length broke out, and bore down all before it. In the firſt place, he reſolved not only to write no more plays, but to do a rigorous penance for thoſe he had written ; and he actually formed a deſign of becoming a Carthuſian friar. His religious director, however, a good deal wiſer than he, adviſed him to think more moderately, and to take meaſures more ſuitable to his character. He put him upon marrying, and ſettling in the world : with which propoſal this humble and tractable penitent complied ; and immediately took to wife the daughter of a treaſurer of France for Amiens, by whom he had ſeven children.

He had been admitted a member of the French academy in 1673, in the room of La Mothe le Vayer deceaſed ; but ſpoiled the ſpeech he had made upon that occaſion by pronouncing it with too much timidity. In 1677, he was nominated with Boileau, with whom he was ever in ſtrict friendſhip, to write the hiſtory of Louis XIV. ; and the public expected great things from two writers of their diſtinction, but were diſappointed. Boileau and Racine, after having for ſome time laboured at this work, perceived that it was entirely oppoſite to their genius.

He ſpent the latter years of his life in compoſing a hiſtory of the houſe of Port-Royal, the place of his education ; which, however, though finely drawn up, as many have aſſerted, has not been publiſhed. Too great ſenſibility, ſay his friends, but more properly an impotence of ſpirit, ſhortened the days of this poet.—Though he had converſed much with the court, he had not learned the wiſdom, which is uſually learned there, of diſguiſing his real ſentiments. Having drawn up a well-reaſoned and well-written memorial upon the miſeries of the people, and the means of relieving them, he one day lent it to Madam de Maintenon to read ; when the king coming in, and demanding what and whoſe it was, commended the zeal of Racine, but diſapproved of his meddling with things that did not concern him : and ſaid with an angry tone, "Becauſe he knows how to make good verſes, does he think he knows every thing ? And would he be a miniſter of ſtate, becauſe he is a great poet ?" Theſe words hurt Racine greatly : he conceived dreadful ideas of the king's diſpleaſure ; and his chagrin and fears brought on a fever, of which he died the 22d of April 1699.

The king, who was ſenſible of his great merit, and always loved him, ſent often to him in his illneſs ; and finding after his death that he had more glory than riches, ſettled a handſome penſion upon his family.—There is nothing in the French language written with more wit and elegance than his pieces in proſe. Beſides his plays, ſeveral of his letters have been publiſhed ; he alſo wrote ſpiritual ſongs, epigrams, &c. Racine's works were printed at Amſterdam in 1722, in 2 vols. 12mo, and the next year a pompous edition was printed in 2 vols. quarto.

RACING, the riding heats for a plate, or other premium. See Plate. The amuſement of horſe-racing, which is now ſo common, was not unknown among the great nations of antiquity, nor wholly unpractiſed by our anceſtors in Britain, as we have already mentioned in the article Race. In 1599, private matches between gentlemen, who were their own jockies and riders, were very common; and, in the reign of James I. public races were eſtabliſhed at various places, when the diſcipline, and mode of preparing the horſes for running, &c. were much the ſame as they are now. The moſt celebrated races of that time were called bell-courſes, the prize of the conqueror being a bell: hence, perhaps, the phraſe of *bearing the bell*, when applied to excellence, is derived. In the latter end of Charles I.'s reign, races were performed in Hyde-Park. Newmarket was alſo a place for the ſame purpoſe, though it was firſt uſed for hunting. Racing was revived ſoon after the Reſtoration, and much encouraged by Charles II. who appointed races for his own amuſement at Datchet Mead, when he reſided at Windſor. Newmarket, however, now became the principal place. The king attended in perſon, eſtabliſhed a houſe for his own accommodation, and kept and entered horſes in his own name. Inſtead of bells, he gave a ſilver bowl or cup value 100 guineas; on which prize the exploits and pedigree of the ſucceſsful horſe were generally engraved. Inſtead of the cup or bowl, the royal gift is now a hundred guineas. William III. not only added to the plates, but even founded an academy for riding; and Queen Anne continued the bounty of her anceſtors, adding ſeveral plates herſelf. George I. towards the end of his reign, diſcontinued the plates, and gave in their room a hundred guineas. An act was paſſed in the 13th year of the reign of George II. for ſuppreſſing races by poneys and other ſmall and weak horſes, &c. by which all matches for any prize under the value of 50l. are prohibited, under a penalty of 200l. to be paid by the owner of each horſe running, and 100l. by ſuch as advertiſe the plate; and by which each horſe entered to run, if five years old, is obliged to carry ten ſtones; if ſix, eleven; and if ſeven, twelve. It is alſo ordained, that no perſon ſhall run any horſe at a courſe, unleſs it be his own, nor enter more than one horſe for the ſame plate, upon pain of forfeiting the horſes; and alſo every horſe-race muſt be begun and ended in the ſame day. Horſes may run for the value of 50l. with any weight, and at any place. 13 Geo. II. cap. 19. 18 Geo. II. cap. 34. Pennant's Britiſh Zoology, vol. i. p. 6, &c. Berenger's Hiſtory and Art of Horſemanſhip, vol. i. p. 185, &c. At Newmarket there are two courſes, the long and the round: the firſt is exactly four miles and about 380 yards, *i. e.* 7420 yards. The ſecond is 6640 yards. Childers, the ſwifteſt horſe ever known, has run the firſt courſe in ſeven minutes and a half, and the ſecond in ſix minutes forty ſeconds; which is at the rate of more than forty-nine feet in a ſecond. But all other horſes take up at leaſt ſeven minutes and fifty ſeconds in completing the firſt and longeſt courſe, and ſeven minutes only in the ſhorteſt, which is at the rate of more than forty-ſeven feet in a ſecond. And it is commonly ſuppoſed that theſe courſers cover, at every bound, a ſpace of ground in length about twenty-four Engliſh feet. Race-horſes have been for ſome time an object of taxation.

RACHITIS, the Rickets. See Medicine, n° 347.

RACK (Edmund), a perſon well known in the literary world by his attachment to, and promotion of, agricultural knowledge: he was a native of Norfolk (England), a Quaker. His education was common, and he was apprenticed originally to a ſhopkeeper: his ſociety was ſelect in this ſituation, and by improving himſelf in learning, his converſation was enjoyed by a reſpectable acquaintance. He wrote many eſſays, poems, and letters, and ſome few controverſial tracts. At length he ſettled, about his 40th year, at Bath in 1775, and was ſoon introduced to the moſt eminent literati of that place, among whom Dr Wilſon and Mrs Macaulay highly eſteemed him for his integrity and abilities. In 1777 he publiſhed *Mentor's Letters*, a moral work, which has run through many editions. But this year he gained great celebrity by his plan of an agricultural ſociety, which was ſoon adopted by four counties. He ſtill further advanced his fame by his papers in the Farmer's Magazine, and his communications in the Bath Society's papers; a work remarkable for its ingenuity and ſpirit. His laſt engagement was in the Hiſtory of Somerſetſhire, where the topographical parochial ſurveys were his. This work, in 3 vols 4to, was publiſhed in 1791, by his colleague the Reverend Mr Collinſon.—Mr Rack died of an aſthma in February 1787, aged 52.

Rack, an engine of torture, furniſhed with pulleys, cords, &c. for extorting confeſſion from criminals.—The trial by rack is utterly unknown to the law of England; though once, when the dukes of Exeter and Suffolk, and other miniſters of Henry VI. had laid a deſign to introduce the civil law into Britain as the rule of government; for a beginning thereof they erected a rack for torture, which was called in deriſion the duke of Exeter's daughter, and ſtill remains in the Tower of London, where it was occaſionally uſed as an engine of ſtate, not of law, more than once in the reign of Queen Elizabeth. But when, upon the aſſaſſination of Villiers duke of Buckingham, by Felton, it was propoſed in the privy council to put the aſſaſſin to the rack, in order to diſcover his accomplices; the judges, being conſulted, declared unanimouſly, to their own honour and the honour of the Engliſh law, that no ſuch proceeding was allowable by the laws of England. It ſeems aſtoniſhing that this uſage of adminiſtering the torture ſhould be ſaid to ariſe from a tenderneſs to the lives of men; and yet this is the reaſon given for its introduction in the civil law, and its ſubſequent adoption by the French and other foreign nations, viz. becauſe the laws cannot endure that any man ſhould die upon the evidence of a falſe, or even a ſingle witneſs, and therefore contrived this method that innocence ſhould manifeſt itſelf by a ſtout denial, or guilt by a plain confeſſion: thus rating a man's virtue by the hardineſs of his conſtitution, and his guilt by the ſenſibility of his nerves. The Marquis Beccaria, in an exquiſite piece of raillery, has propoſed this problem, with a gravity and preciſion that are truly mathematical: "The force of the muſcles and the ſenſibility of the nerves of an innocent perſon being given; it is required to find the degree of pain neceſſary to make him confeſs himſelf guilty of a given crime." See *Act of Faith*, Inquisition, and Torture.

Rack, a ſpirituous liquor made by the Tartars of Tonguſa. This kind of rack is made of mare's milk, which is left to be ſour, and afterwards diſtilled twice or thrice between two earthen pots cloſely ſtopped; whence the liquor runs through a ſmall wooden pipe. This liquor is more intoxicating than brandy diſtilled from wine.

Rack, or *Arack*. See Arack.

To Rack *Wines, &c.* To draw them off from their lees, after having ſtood long enough to ebb and ſettle. Hence rack-vintage is frequently uſed for the ſecond voyage the wine-merchants uſe to make into France for racked wines.

RACKOON, in zoology, a ſpecies of Ursus.

RACONI, a populous town of Italy, in Piedmont, ſeated in a pleaſant plain, on the road from Savillan to Turin, on the rivers Grana and Macra. It belongs to the prince of Carignan, who has a handſome caſtle here. It is ſix miles from Savillan, and ſix from Carignan. E. Long. 7. 46. N. Lat. 44. 39.

RADCLIFFE (Dr John), an Engliſh phyſician of great eminence in his time, born at Wakefield in Yorkſhire in 1650. He was educated at Oxford, and enrolled himſelf upon the phyſical line; but it was remarkable that he recommended himſelf more by his ready wit and vivacity, than by any extraordinary acquiſitions in learning. He began to practice at Oxford in 1675; but never paid any regard to eſtabliſhed rules, which he cenſured whenever he thought fit, with great freedom and acrimony; and as this drew all the old practitioners upon him, he lived in a continual ſtate of hoſtility with them. Nevertheleſs, his reputation increaſed with his experience; ſo that, before he had been two years in buſineſs, his practice was very extenſive among perſons of high rank. In 1684 he removed to London, and ſettled in Bow-ſtreet, Covent Garden, where in leſs than a year he got into prime buſineſs.—In 1687 the princeſs Anne of Denmark made him her phyſician: yet when her huſband and ſhe joined the prince of Orange, Radcliffe, either not chooſing to declare himſelf, or unwilling to favour the meaſures then in agitation, excuſed himſelf from attending them, on the plea of the multitude of his patients. Nevertheleſs, he was often ſent for to King William and other great perſonages, though he did not incline to be a courtier. He incurred ſome cenſure for his treatment of Q. Mary, who died of the ſmall-pox; and ſoon after loſt his place about the princeſs Anne, by his attachment to his bottle. He alſo totally loſt the favour of K. William by his uncourtly freedom; for, in 1689, when the king ſhowed him his ſwollen ancles, while the reſt of his body was emaciated, and aſked him what he thought of them? "Why truly I would not have your majeſty's two legs for your three kingdoms," replied Radcliffe. He continued increaſing in buſineſs and inſolence as long as he lived, continually at war with his brethren the phyſicians; who conſidered him in no other light than that of an active ingenious empiric, whom conſtant practice had at length brought to ſome degree of ſkill in his profeſſion. He died in 1714; and if he never attempted to write any thing himſelf, has perpetuated his memory by founding a fine library at Oxford, to preſerve the writings of other men.

RADIALIS, the name of two muſcles in the arm. See Anatomy, *Table of the Muſcles*.

RADIANT, in optics, is any point of a viſible object from whence rays proceed.

RADIATED flowers, in botany, are ſuch as have ſeveral ſemifloſcules ſet round a diſk, in form of a radiant ſtar; thoſe which have no ſuch rays are called *diſcous flowers*.

RADIATION, the act of a body emitting or diffuſing rays of light all round as from a centre.

RADICAL, in general, ſomething that ſerves as a baſis or foundation. Hence phyſicians talk much of a radical moiſture. In grammar, we give the appellation *radical* to primitives, in contradiſtinction to compounds and derivatives. Algebraiſts alſo ſpeak of the radical ſign of quantities, which is the character expreſſing their roots.

RADICLE, that part of the ſeeds of all plants which upon vegetating becomes their root, and is diſcoverable by the microſcope. See Plant.

RADISH, in botany, See Raphanus.

RADIUS, in geometry, the ſemidiameter of a circle, or a right line drawn from the centre to the circumference.

In trigonometry, the radius is termed the whole ſine, or ſine of 90°. See Sine.

Radius, in anatomy, the exterior bone of the arm, deſcending along with the ulna from the elbow to the wriſt.

RADNOR, the county-town of Radnorſhire, in South Wales. It is a poor little place, diſtant from London about 150 miles. It is ſituated near the ſpring-head of the river Somergil, in a fruitful valley at the bottom of a hill, where there are ſheep grazing in abundance. It is a very ancient borough-town, whoſe juriſdiction extends near 12 miles round about: the government of it is veſted in a bailiff and 25 burgeſſes. Though it is the county-town, the aſſizes are held at Preſteign: it has one privilege, however, that is very extraordinary, beſides that of ſending one member to parliament; and that is, it keeps a court of pleas for all actions, without being limited to any particular ſum. It was formerly fenced with a wall and a ſtrong caſtle; but both were in a great meaſure demoliſhed by Owen Glendower, when he aſſumed the title of Prince of Wales, upon the depoſition of King Richard II. W. Long. 2. 45. N. Lat. 52. 10.

RADNORSHIRE, a county of South Wales, is bounded on the north by Montgomeryſhire; on the eaſt by Shropſhire and Herefordſhire; on the ſouth and ſouth-weſt by Brecknockſhire; and on the weſt by Cardiganſhire; extending 30 miles in length and 25 in breadth. This county is divided into ſix hundreds, in which are contained three market-towns, 52 pariſhes, about 3160 houſes, and 18,960 inhabitants. It is ſeated in the dioceſe of Hereford, and ſends two members to parliament, one for the county and one for the town of Radnor. The air of this county is in winter cold and piercing. The ſoil in general is but indifferent; yet ſome places produce corn, particularly the eaſtern and ſouthern parts; but in the northern and weſtern, which are mountainous, the land is chiefly ſtocked with horned cattle, ſheep, and goats.

RADIX. See Root.

RAFT, a ſort of float, formed by an aſſemblage of various planks or pieces of timber, faſtened together ſide by ſide, ſo as to be conveyed more commodiouſly to any ſhort diſtance in a harbour or road than if they were ſeparate. The timber and plank with which merchant-ſhips are laden, in the different parts of the Baltic Sea, are attached together in this manner, in order to float them off to the ſhipping.

RAFTERS, in building, are pieces of timber which, ſtanding by pairs on the reaſon or railing piece, meet in an angle at the top, and form the roof of a building. See ARCHITECTURE.

ROWLEY RAGG, a genus of ſtones, belonging to the ſiliceous claſs. It is of a duſky or dark grey colour, with many ſmall ſhining cryſtals, having a granular texture, and acquiring an ochry cruſt by expoſure to the air. The ſpecific gravity is 2748. It becomes magnetic by being heated in an open fire. In a ſtrong fire it melts without addition, but with more difficulty than baſaltes. It was analyſed by Dr Withering, who found that 100 parts of it contain 47.5 of ſiliceous earth, 32.5 of argil, and 20 of iron.

RAGMAN'S ROLL, Rectius Ragimund's roll, ſo called from one Ragimund a legate in Scotland, who calling before him all the beneficed clergymen in that kingdom, cauſed them on oath to give in the *the true value* of their benefices; according to which they were afterwards taxed by the court of Rome; and this roll, among other records, being taken from the Scots by Edward I. was re-delivered to them in the beginning of the reign of Edward III.

RAGOUT, or RAGOO, a ſauce, or ſeaſoning, intended to rouſe the appetite when loſt or languiſhing.

This term is alſo uſed for any high-ſeaſoned diſh prepared of fleſh, fiſh, greens, or the like: by ſtewing them with bacon, ſalt, pepper, cloves, and the like ingredients. We have ragouts of celery, of endive, aſparagus, cock's combs, giblets, craw-fiſh, &c.

The ancients had a ragout called *garum*, made of the putrified guts of a certain fiſh kept till it diſſolved into a mere ſanies, which was thought ſuch a dainty, that, according to Pliny, its price equalled that of the richeſt perfumes.

RAGSTONE, a genus of ſtones belonging to the claſs of ſiliceous earths. It is of a grey colour; the texture obſcurely laminar, or rather fibrous; but the laminæ or fibres conſiſt of a congeries of grains of a quartzy appearance, coarſe and rough. The ſpecific gravity is 2729; it efferveſces with acids, and ſtrikes fire with ſteel. Mr Kirwan found it to contain a portion of mild calareous earth, and a ſmall proportion of iron. It is uſed as a whetſtone for coarſe cutting tools. It is found about Newcaſtle, and many other parts of England, where there are large rocks of it in the hills.

RAGULED; or RAGGED, in heraldry, jagged or knotted. This term is applied to a croſs formed of the trunks of two trees without their branches, of which they ſhow only the ſtumps. *Raguled* differs from *indented*, in that the latter is regular, the former not.

RAGUSA, an ancient town of Sicily, in the Val-di-Noto, near the river Maulo, 12 miles north of Modica. E. Long. 14. 59. N. Lat. 37. 0.

RAGUSA, a city of Dalmatia, and capital of Raguſen. It is about two miles in circumference, is pretty well built, and ſtrong by ſituation, having an inacceſſible mountain on the land-ſide, and on the ſide of the ſea a ſtrong fort. It has an archbiſhop's ſee and a republic, and has a doge like that of Venice, but he continues a month only in his office. It carries on a conſiderable trade with the Turks, and is 60 miles north-weſt of Scutari, and 110 north of Brindiſi. E. Long 18. 10. N. Lat. 42. 50.

RAGUSEN, a territory of Europe in Dalmatia, lying along the coaſt of the gulph of Venice, about 55 miles in length, and 20 in breadth. It is a republic under the protection of the Turks and Venetians. Raguſa is the capital town.

RAJA, the title of the Indian black princes, the remains of thoſe who ruled there before the Moguls. Some of the rajas are ſaid to preſerve their independency, eſpecially in the mountainous parts; but moſt of them pay an annual tribute to the Mogul. The Indians call them *rai*; the Perſians, *raian*, in the plural; and our travellers *rajas*, or *ragias*.

RAJA, the *Ray-Fiſh*, in ichthyology; a genus belonging to the order of Chondropterygia. There are five ſpiracula below towards the peak; the body compreſſed; and the mouth is ſituated under the head. The moſt remarkable ſpecies are,

1. The batis, or ſkate: this ſpecies is the thinneſt in proportion to its bulk of any of the genus, and alſo the largeſt, ſome weighing near 200 pounds. The noſe, though not long, is ſharp pointed; above the eyes is a ſet of ſhort ſpines: the upper part is of a pale brown, ſometimes ſtreaked with black: the lower part is white, marked with great numbers of minute black ſpots. The jaws are covered with ſmall granulated but ſharp-pointed teeth. The tail is of a moderate length: near the end are two fins: along the top of it is one row of ſpines, and on the edges are irregularly diſperſed a few others, which makes us imagine with Mr Ray, that in this reſpect theſe fiſh vary, ſome having one, others more orders of ſpines on the tail. It is remarked, that in the males of this ſpecies the fins are full of ſpines. Skates generate in March and April; at which time they ſwim near the ſurface of the water, ſeveral of the males purſuing one female. They adhere ſo faſt together in coition, that the fiſhermen frequently draw up both together, though only one has taken the bait. The females begin to caſt their *purſes*, as the fiſhermen call them (the bags in which the young are included) in May, and continue doing it till September. In October they are exceedingly poor and thin; but in November they begin to improve, and grow gradually better till May, when they are in the higheſt perfection. The males go ſooner out of ſeaſon than the females.

2. The oxyrinchus, or ſharp-noſed ray, in length near ſeven feet, and breadth five feet two inches; when juſt brought on ſhore it makes a remarkable ſnorting noiſe. The noſe is very long, narrow, and ſharp-pointed, not unlike the end of a ſpontoon. The body is ſmooth, and very thin in proportion to the ſize; the upper part aſh-coloured, ſpotted with numerous white ſpots, and a few black ones. The tail is thick; towards the end are two ſmall fins; on each ſide is a row of ſmall ſpines, with another row in the middle, which runs ſome way up the back. The lower part of the fiſh is quite white. The mouth is very large, and furniſhed with numbers of ſmall ſharp teeth bending inwards. This fiſh has been ſuppoſed to be the *bos* of the ancients;

cients; which was certainly ſome enormous ſpecies of ray, though we cannot pretend to determine the particular kind. Oppian ſtyles it, *the broadeſt among fiſhes:* he adds an account of its fondneſs of human fleſh, and the method it takes of deſtroying men, by over-laying and keeping them down by its vaſt weight till they are drowned. Phile *(De propriet. anim.* p. 85.) gives much the ſame relation. We are inclined to give them credit, ſince a modern writer, of undoubted authority*, gives the very ſame account of a fiſh found in the South Seas, the terror of thoſe employed in the pearl-fiſhery. It is a ſpecies of ray, called there *manta*, or the *quilt*, from its ſurrounding and wrapping up the unhappy divers till they are ſuffocated; therefore the negroes never go down without a ſharp knife to defend themſelves againſt the aſſaults of this terrible enemy.

3. The aſpera, or rough ray, is found in Loch-Broom in Scotland. The length from the noſe to the tip of the tail is two feet nine. The tail is almoſt of the ſame length with the body. The noſe is very ſhort. Before each eye is a large hooked ſpine; and behind each another, beſet with leſſer. The upper part of the body is of a cinereous brown mixed with white, and ſpotted with black; and entirely covered with ſmall ſpines. On the tail are three rows of great ſpines: all the reſt of the tail is irregularly beſet with leſſer. The fins and under ſide of the body are equally rough with the upper. The teeth are flat and rhomboidal.

4. The fullonica, or fuller, derives its Latin name from the inſtrument fullers make uſe of in ſmoothing cloth, the back being rough and ſpiney. The noſe is ſhort and ſharp. At the corner of each eye are a few ſpines. The membrane of nictitation is fringed. Teeth ſmall and ſharp. On the upper part of the pectoral fins are three rows of ſpines pointing towards the back, crooked like thoſe on a fuller's inſtrument. On the tail are three rows of ſtrong ſpines: the middle row reaches up part of the back. The tail is ſlender, and rather longer than the body. The colour of the upper part of the body is cinereous, marked uſually with numerous black ſpots: the lower part is white. This, as well as moſt other ſpecies of rays, vary a little in colour, according to age. This grows to a ſize equal to the ſkate. It is common at Scarborough, where it is called the *white hans*, or *gullet*.

5. The ſhagreen ray increaſes to the ſize of the ſkate; is fond of launces or ſand-eels, which it takes generally as a bait. The form is narrower than that of the common kinds; the noſe long and very ſharp; pupil of the eye ſapphirine; on the noſe are two ſhort rows of ſpines; on the corner of the eyes another of a ſemicircular form; on the tail are two rows, continued a little up the back, ſmall, ſlender, and very ſharp: along the ſides of the tail is a row of minute ſpines, intermixed with innumerable little ſpiculæ. The upper part of the body is of a cinereous brown, covered cloſely with ſhagreen-like tubercles, reſembling the ſkin of the dog-fiſh: the under ſide of the body is white; from the noſe to the beginning of the pectoral fins is a tuberculated ſpace. The teeth ſlender, and ſharp as needles.

6. The torpedo, cramp-fiſh, or electric ray, is frequently taken in Torbay: has been once caught off Pembroke, and ſometimes near Waterford in Ireland. It is generally taken, like other flat fiſh, with the trawl; but there is an inſtance of its taking the bait. It commonly lies in water of about 40 fathoms depth; and in company with the congenerous rays. The torpedo brings forth its young at the autumnal equinox, as affirmed by Ariſtotle. A gentleman of La Rochelle, on diſſecting certain females of this ſpecies, the 10th of September, found in the matrices ſeveral of the fœtuſes quite formed, and nine eggs in no ſtate of forwardneſs: ſuperfœtation ſeems therefore to be a property of this fiſh. The food of the torpedo is fiſh; a ſurmullet and a plaiſe have been found in the ſtomach of two of them. The ſurmullet is a fiſh of that ſwiftneſs, that it was impoſſible for the torpedo to take it by purſuit. It is probable, therefore, that by their electric ſtroke they ſtupify their prey; yet the crab and ſea-leech will venture to annoy them. They will live 24 hours out of the ſea; and but very little longer if placed in freſh water. They inhabit ſandy places; and will bury themſelves ſuperficially in it, by flinging the ſand over, by a quick flapping of all the extremities. It is in this ſituation that the torpedo gives his moſt forcible ſhock, which throws down the aſtoniſhed paſſenger who inadvertently treads upon him. In theſe ſeas it grows to a great ſize, and above 80 pounds weight. The tail is thick and round; the caudal fin broad and abrupt. The head and body, which are indiſtinct, are nearly round; attenuating to extreme thinneſs on the edges; below the body, the ventral fins form on each ſide a quarter of a circle. The two dorſal fins are placed on a trunk of the tail. The eyes are ſmall, placed near each other: behind each is a round ſpiracle, with ſix ſmall cutaneous rags on their inner circumference. Mouth ſmall; teeth minute, ſpicular. Five openings to the gills, as in others of this genus. The ſkin everywhere ſmooth; cinereous brown above, white beneath. See further the article ELECTRICITY, n° 258—261.

7. The clavata, or thornback, is eaſily diſhinguiſhed from the others by the rows of ſtrong ſharp ſpines diſpoſed along the back and tail. In a large one ſeen by Mr Pennant, were three rows on the back, and five on the tail, all inclining towards its end. On the noſe, and on the inner ſide of the forehead, near the eyes, were a few ſpines, and others were ſcattered without any order on the upper part of the pectoral fins. The mouth was ſmall, and filled with granulated teeth: The upper part of the body was of a pale aſh colour, marked with ſhort ſtreaks of black, and the ſkin rough, with ſmall tubercles like ſhagreen. The belly white, croſſed with a ſtrong ſemilunar cartilage beneath the ſkin: in general, the lower part was ſmooth, having only a few ſpines on each ſide. The young fiſh have very few ſpines on them; and their backs are often ſpotted with white, and each ſpot is encircled with black. This ſpecies frequents the ſandy ſhores; are very voracious, and feed on all ſorts of flat fiſh; are particularly fond of herrings and ſand-eels; and ſometimes eat cruſtaceous animals, ſuch as crabs. Theſe ſometimes weigh 14 or 15 pounds, but with ſeldom exceed that weight. They begin to generate in June, and bring forth their young in July and Auguſt, which (as well as thoſe of the ſkate) before they are old enough to breed, are called *maids*. The thornback begins to be in ſeaſon in November, and continues ſo later than the ſkate, but the young of both are good at all times of the year.

8. The paſtinaca, or ſting ray, does not grow to the bulk of the others: The body is quite ſmooth, of ſhape almoſt round, and is of a much greater thickneſs and

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* Ulloa's Voyage, I. 132.

more elevated form in the middle than any other ways, but grows thin towards the edges. The noſe is very ſharp pointed, but ſhort; the mouth ſmall, and filled with granulated teeth. The irides are of a gold colour: behind each eye the orifice is very large. The tail is very thick at the beginning: the ſpine is placed about a third the length of the former from the body; is about five inches long, flat on the top and bottom, very hard, ſharp pointed, and the two ſides thin, and cloſely and ſharply bearded the whole way. The tail extends four inches beyond the end of this ſpine, and grows very ſlender at the extremity. Theſe fiſh are obſerved to ſhed their ſpines, and renew them annually; ſometimes the new ſpine appears before the old one drops off; and the Corniſh call this ſpecies *cardinal triloſt*, or *three-tailed*, when ſo circumſtanced. The colour of the upper part of the body is a dirty yellow, the middle part of an obſcure blue: the lower ſide white, the tail and ſpine duſky. The weapon with which nature has armed this fiſh, hath ſupplied the ancients with many tremendous fables relating to it. Pliny, Ælian, and Oppian, have given it a venom that affects even the inanimate creation: trees that are ſtruck by it inſtantly loſe their verdure and periſh, and rocks themſelves are incapable of reſiſting the potent poiſon. The enchantreſs Circe armed her ſon with a ſpear headed with the ſpine of the trygon, as the moſt irreſiſtible weapon ſhe could furniſh him with; and with which he afterwards committed parricide, unintentionally, on his father Ulyſſes. That ſpears and darts might, in very early times, have been headed with this bone inſtead of iron, we have no kind of doubt; that of another ſpecies of this fiſh being ſtill uſed to point the arrows of ſome of the South American Indians, and is, from its hardneſs, ſharpneſs, and beards, a moſt dreadful weapon. But in reſpect to its venomous qualities, there is not the leaſt credit to be given to the opinion, though it was believed (as far as it affected the animal world) by Rondeletius, Aldrovand, and others, and even to this day by the fiſhermen in ſeveral parts of the world. It is in fact the weapon of offence belonging to the fiſh, capable of giving a very bad wound, and which is attended with dangerous ſymptoms when it falls on a tendinous part or on a perſon in a bad habit of body. As to any fiſh having a ſpine charged with actual poiſon, it ſeems very dubious, though the report is ſanctified by the name of Linnæus. He inſtances the *paſtinaca*, the *torpedo*, and the *tetrodon lineatus*. The firſt is incapable of conveying a greater injury than what reſults from the mere wound; the ſecond, from its electric effluvia; and the third, by imparting a pungent pain like the ſting of nettles, occaſioned by the minute ſpines on its abdomen.

RAIANIA, in botany: A genus of the hexandria order, belonging to the dioecia claſs of plants; and in the natural method ranking under the 11th order, *Sarmentaceæ*. The male calyx is ſexpartite; there is no corolla. The female calyx as in the male, without any corolla; there are three ſtyles; the fruit is roundiſh with an oblique wing, inferior. There are three ſpecies, the haſtata, cordata, and quinquefolia.

RAIETEA, one of the South Sea iſlands, named alſo Ulietea.

RAIL, in ornithology. See Rallus.

RAILLERY, according to Dr Johnſon, means ſlight ſatire, or ſatirical merriment: and a beautiful writer of the laſt century compares it to a light which dazzles, and which does not burn. It is ſometimes innocent and pleaſant, and it ſhould always be ſo, but it is moſt frequently offenſive. Raillery is of various kinds; there is a ſerious, ſevere, and good-humoured raillery; and there is a kind which perplexes, a kind which offends, and a kind which pleaſes.

To rally well, it is abſolutely neceſſary that kindneſs run through all you ſay; and you muſt ever preſerve the character of a friend to ſupport your pretenſions to be free with a man. Alluſions to paſt follies, hints to revive what a man has a mind to forget for ever, ſhould never be introduced as the ſubjects of raillery. This is not to thruſt with the ſkill of fencers, but to cut with the barbarity of butchers. But it is below the character of men of humanity and good-breeding to be capable of mirth, while there is any in the company in pain and diſorder.

RAIN, the deſcent of water from the atmoſphere in the form of drops of a conſiderable ſize. By this circumſtance it is diſtinguiſhed from dew and fog: in the former of which the drops are ſo ſmall that they are quite inviſible; and in the latter, though their ſize is larger, they ſeem to have very little more ſpecific gravity than the atmoſphere itſelf, and may therefore be reckoned hollow ſpherules rather than drops.

It is univerſally agreed, that rain is produced by the water previouſly abſorbed by the heat of the ſun, or otherwiſe, from the terraqueous globe, into the atmoſphere; but very great difficulties occur when we begin to explain why the water, once ſo cloſely united with the atmoſphere, begins to ſeparate from it. We cannot aſcribe this ſeparation to cold, ſince rain often takes place in very warm weather; and though we ſhould ſuppoſe the condenſation owing to the ſuperior cold of the higher regions, yet there is a remarkable fact which will not allow us to have recourſe to this ſuppoſition. It is certain that the drops of rain increaſe in ſize conſiderably as they deſcend. On the top of a hill, for inſtance, they will be ſmall and inconſiderable, forming only a drizzling ſhower; but at the bottom of the ſame hill the drops will be exceſſively large, deſcending in an impetuous rain; which ſhows that the atmoſphere is diſpoſed to condenſe the vapours, and actually does ſo, as well where it is warm as where it is cold.

For ſome time the ſuppoſitions concerning the cauſe of rain were exceedingly inſufficient and unſatisfactory. It was imagined, that when various congeries of clouds were driven together by the agitation of the winds, they mixed, and run into one body, by which means they were condenſed into water. The coldneſs of the upper parts of the air alſo was thought to be a great means of collecting and condenſing the clouds into water; which, being heavier than the air, muſt neceſſarily fall down through it in the form of rain. The reaſon why it falls in drops, and not in large quantities, was ſaid to be the reſiſtance of the air; whereby being broken, and divided into ſmaller and ſmaller parts, it at laſt arrives to us in ſmall drops. But this hypotheſis is entirely contrary to almoſt all the phenomena: for the weather, when coldeſt, that is, in the time of ſevere froſt, is generally the moſt ſerene; the moſt violent rains alſo happen where there is little or no cold to condenſe the clouds; and the drops of rain, inſtead of being divided into ſmaller and ſmaller ones as they approach the earth, are plainly increaſed in ſize as they deſcend.

Dr Derham accounted for the precipitation of the drops of rain from the veſiculæ being full of air, and meeting with an air colder than they contained, the air they contained was of conſequence contracted into a ſmaller ſpace; and conſequently the watery ſhell rendered thicker, and thus ſpecifically heavier, than the common atmoſphere. But it has been ſhown, that the veſiculæ, if ſuch they are, of vapour, are not filled with air, but with fire, or heat; and conſequently, till they part with this latent heat, the vapour cannot be condenſed §. Now, cold is not always ſufficient to effect this, ſince in the moſt ſevere froſts the air is very often ſerene, and parts with little or none of its vapour for a very conſiderable time. Neither can we admit the winds to have any conſiderable agency in this matter, ſince we find that blowing upon vapour is ſo far from condenſing it, that it unites it more cloſely with the air, and wind is found to be a great promoter of evaporation.

According to Rohault, the great cauſe of rain is the heat of the air; which, after continuing for ſome time near the earth, is raiſed on high by a wind, and there thawing the ſnowy villi or flocks of half-frozen veſiculæ, reduces them to drops; which, coaleſcing, deſcend. Here, however, we ought to be informed by what means theſe veſiculæ are ſuſpended in their half-frozen ſtate; ſince the thawing of them can make but little difference in their ſpecific gravity, and it is certain that they aſcended through the air not in a frozen but in an aqueous ſtate.

Dr Clarke and others aſcribe this deſcent of the rain rather to an alteration of the atmoſphere than of the veſiculæ; and ſuppoſe it to ariſe from a diminution of the elaſtic force of the air. This elaſticity, which, they ſay, depends chiefly or wholly upon terrene exhalations, being weakened, the atmoſphere ſinks under its burden, and the clouds fall. Now, the little veſicles being once upon the deſcent, will continue therein, notwithſtanding the increaſe of reſiſtance they every moment meet with. For, as they all tend to the centre of the earth, the farther they fall, the more coalitions they will make; and the more coalitions, the more matter will there be under the ſame ſurface; the ſurface increaſing only as the ſquares, but the ſolidity as the cubes; and the more matter under the ſame ſurface, the leſs reſiſtance will there be to the ſame matter. Thus, if the cold, wind, &c. act early enough to precipitate the aſcending veſicles before they are arrived at any conſiderable height, the coalitions being but few, the drops will be proportionably ſmall; and thus is formed a dew. If the vapours be more copious, and riſe a little higher, we have a miſt or fog. A little higher ſtill, and they produce a ſmall rain; if they neither meet with cold nor wind, they form a heavy thick dark ſky. This hypotheſis is equally unſatisfactory with the others; for, granting that the deſcent and condenſation of the vapours are owing to a diminution of the atmoſphere's elaſticity, by what is this diminution occaſioned? To ſay that it is owing to terrene exhalations, is only ſolving one difficulty by another; ſince we are totally unacquainted both with the nature and operation of theſe exhalations. Beſides, let us ſuppoſe the cauſe to be what it will, if it acts equally and at once upon all the vapour in the air, then all that vapour muſt be precipitated at once; and thus, inſtead of gentle ſhowers continuing for a conſiderable length of time, we ſhould have the moſt violent water-ſpouts, continuing only for a few minutes, or perhaps ſeconds, which, inſtead of refreſhing the earth, would drown and lay waſte every thing before them.

Since philoſophers have admitted the electric fluid to ſuch a large ſhare in the operations of nature, almoſt all the natural phenomena have been accounted for by the action of that fluid; and rain, among others, has been reckoned an effect of electricity. But this word, unleſs it is explained, makes us no wiſer than we were before; the phenomena of artificial electricity having been explained on principles which could ſcarce apply in any degree to the electricity of nature: and therefore all the ſolution we can obtain of the natural appearances of which we ſpeak, comes to this, that rain is occaſioned by a moderate electrification, hail and ſnow by one more violent, and thunder by the moſt violent of all; but in what manner this electrification is occaſioned, hath not yet been explained. Throughout the various parts of this work where electricity hath been occaſionally mentioned, the principles of artificial electricity ||, laid down in the treatiſe appropriated to that ſubject, have been applied to the ſolution of the phenomena of nature; thoſe which are neceſſary to be attended to here are the following:

1. The electric fluid and ſolar light are the ſame ſubſtance in two different modifications.

2. Electricity is the motion of the fluid when running, or attempting to run, in a continued ſtream from one place to another: heat is when the fluid has no tendency but to vibrate outwards and inwards to and from a centre; or at leaſt when its ſtreams converge to a point or focus.

3. The fluid acting as electricity, like water, or any other fluid, always tends to the place where there is leaſt reſiſtance.

On theſe three principles may the phenomena of atmoſpherical electricity, and the deſcent of rain by its means, be explained as follows:

1. The light or heat of the ſun, acting in that peculiar manner which we call *heat*, unites itſelf with the moiſture of the earth, and forms it into vapour, which thus becomes ſpecifically lighter than air, and of conſequence aſcends in the atmoſphere to a certain height.

2. Beſides the quantity of light which is thus united to the water, and forms it into vapour, a very conſiderable quantity enters the earth, where it aſſumes the nature of electric fluid.

3. As the earth is always full of that fluid, every quantity which enters muſt diſplace an equal quantity which is already there.

4. This quantity which is diſplaced muſt eſcape either at a diſtance from the place where the other enters, or very near it.

5. At whatever place a quantity of electric matter eſcapes, it muſt electriſy the air above that place where it has eſcaped; and as a conſiderable quantity of light muſt always be reflected from the earth into the atmoſphere, where it does not combine with the aqueous vapour, we have thence another ſource of electricity to the air; as this quantity muſt undoubtedly aſſume the action of electric fluid, eſpecially after the action of the ſun has ceaſed. Hence the rea-

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§ See Chemiſtry, n° 124, &c.

|| See Electricity, n° 201, 216, &c.

ſon why in ſerene weather the atmoſpherical electricity is always ſtrongeſt, and rather more ſo in the night than in the day.

6. From theſe conſiderations, we ſee an evident reaſon why there muſt commonly be a difference between the electricity of the earth and that of the atmoſphere, excepting when an earthquake is about to enſue. The conſequence of this muſt be, that as the action of the ſolar light continues to bring down the electric matter, and the earth continues to diſcharge an equal quantity of it into the atmoſphere, ſome part of the atmoſphere muſt at laſt become overloaded with it, and attempt to throw it back into the earth. This attempt will be vain, until a vent is found for the electricity at ſome other place; and as ſoon as this happens, the electrified atmoſphere begins to throw off its ſuperfluous electricity, and the earth to receive it. As the atmoſphere itſelf is a bad conductor, and the more ſo the drier it is, the electric matter attacks the ſmall aqueous particles which are detained in it by means of the latent heat. Theſe being unable to bear the impetus of the fluid, throw out their latent heat, which eaſily eſcapes, and thus makes a kind of vacuum in the electrified part of the atmoſphere. The conſequences of this are, that the aqueous particles being driven together in large quantity, at laſt become viſible, and the ſky is covered with clouds; at the ſame time a wind blows againſt theſe clouds, and, if there is no reſiſtance in the atmoſphere, will drive them away.

7. But if the atmoſphere all round the cloud is exceedingly electrified, and the earth is in no condition to receive the ſuperfluous fluid excepting in that place which is directly under the cloud, then the whole electricity of the atmoſphere for a vaſt way round will tend to that part only, and the cloud will be electrified to an extreme degree. A wind will now blow againſt the cloud from all quarters, more and more of the vapour will be extricated from the air by the electric matter, and the cloud will become darker and thicker, at the ſame time that it is in a manner ſtationary, as being acted upon by oppoſite winds; though its ſize is enlarged with great rapidity by the continual ſupplies of vapour brought by the winds.

8. The vapours which were formerly ſuſpended inviſibly by means of the latent heat are now ſuſpended viſibly by the electric fluid, which will not let them fall to the earth, until it is in a condition to receive the electric matter deſcending with the rain.—It is eaſy to ſee, however, that thus every thing is prepared for a violent ſtorm of thunder and lightning as well as rain. The ſurface of the earth becomes electrified from the atmoſphere: but when this has continued for ſome time, a zone of earth conſiderably below the ſurface acquires an electricity oppoſite to that of the clouds and atmoſphere; of conſequence the electricity in the cloud being violently preſſed on all ſides, will at laſt burſt out towards that zone where the reſiſtance is leaſt, as explained under the article Lightning.—The vapours now having loſt that which ſupported them, will fall down in rain, if there is not a ſufficient quantity of electric matter to keep them in the ſame ſtate in which they were before: but if this happens to be the caſe, the cloud will inſtantly be charged again, while little or no rain will fall; and hence very violent thunder ſometimes takes place without any rain at all, or ſuch as is quite inconſiderable in quantity.

9. When the electricity is leſs violent, the rain will deſcend in vaſt quantity, eſpecially after every flaſh of lightning; and great quantities of electric matter will thus be conveyed to the earth, inſomuch that ſometimes the drops have been obſerved to ſhine as if they were on fire, which has given occaſion to the reports of fiery rain having fallen on certain occaſions. If the quantity of electric matter is ſmaller, ſo that the rain can convey it all gradually to the ground, there will be rain without any thunder; and the greater the quantity of electricity the more violent will be the rain.

From this account of the cauſes of rain, we may ſee the reaſon why in warm climates the rains are exceſſive, and for the moſt part accompanied with thunder; for there the electricity of the atmoſphere is immenſely greater than it is in cold. We may alſo ſee why in certain places, according to the ſituation of mountains, ſeas, &c. the rains will be greater than in others, and likewiſe why ſome parts of the world are exempted from rain altogether; but as a particular diſcuſſion of theſe would neceſſarily include an explanation of the cauſes and phenomena of Thunder, we ſhall for this reaſon refer the whole to be treated of under that article.

Whether this theory be juſt, however, it would be too aſſuming in us to ſay. It may admit of diſpute, for we muſt grant that in the very beſt ſyſtems, though an occurrence ſo frequent, the theory of rain is but very imperfectly underſtood. Dr James Hutton, Fellow of the Royal Society of Edinburgh, whoſe ſpeculations are always ingenious, though generally extraordinary, and much out of the common way, gives us a new theory of rain in the firſt volume of the Tranſactions of that ſociety. It is well known that atmoſpheric air is capable of diſſolving, with a certain degree of heat, a given quantity of water. The Doctor aſcertains the ratio of the diſſolving power of air, in relation to water, in different degrees of heat; and ſhows, that by mixing a portion of tranſparent humid warm air with a portion of cold air, the mixture becomes opake, and part of the water will be precipitated; or, in other words, the vapour will be condenſed into rain. The ratio which he ſtates, however, does not appear to us to be ſupported by experience. Whether the electricity of the air changes in conſequence of its depoſiting the water diſſolved in it, or the change is a cauſe of this depoſition, muſt remain uncertain; but, in either view, there muſt be an agent different from heat and cold, ſince the changes in theſe reſpects do not in other operations change the ſtate of electricity. Dr Hutton ſuppoſes that heat and ſolution do not increaſe by equal increments; but that, in reality, if heat be ſuppoſed to increaſe by equal increments along a ſtraight line, ſolution will be expreſſed by ordinates to a curve whoſe convex ſide is turned towards that line. That the power of ſolution is not increaſed in the ſame ratio with heat, is, however, hypothetical, except when we riſe pretty high in the ſcale, when its proportional increaſe is a little doubtful: and it is not, in this paper, ſupported by experiment. The condenſation of the breath in air is not an obſervation in point, except in air already ſaturated with vapour. It can amount, in any view, to no more than this, that to render it viſible, the heat muſt be diminiſhed in a greater proportion than can be compenſated by the power of ſolution in the body of air, in which the portion expired is at firſt immerſed. To explain rain from this cauſe, we muſt always ſuppoſe a conſtant diminution of heat to take place at the moment of the condenſation of the vapour; but we actually find that the change from a ſtate of vapour to the fluid ſtate is attended with heat; ſo that rain muſt at once oppoſe its own cauſe, and continued rains would be impoſſible, without calling in the aid of other cauſes. From his own ſyſtem, Dr. Hutton endeavours to explain the regular and irregular ſeaſons of rain, either reſpecting the generality of its appearance, or the regularity of its return. And to obviate the apparent exceptions of the theory, from the generality of rain, he explains the proportional quantities of rain, and adds a comparative eſtimate of climates, in relation to rain, with the meteorological obſervations made in our own climate. As his principle is at leaſt inſufficient, and we think erroneous, it would be uſeleſs, even were this a proper place for it, to purſue theſe various branches, which muſt partake of the errors of the ſyſtem. In theſe branches we ought to obſerve, that there are ſeveral juſt obſervations, mixed with errors, becauſe evaporation and condenſation muſt at laſt be the great baſis of every theory: the miſtakes ariſe from not being aware of all the cauſes, and miſrepreſenting the operation of thoſe which do exiſt.

In a work entitled Thoughts on Meteorology, Volume II. M. de Luc conſiders very particularly the grand phenomenon of rain, and the numerous circumſtances connected with it. He examines the ſeveral hypotheſis with conſiderable care; but thinks them, even if admiſſible, utterly inſufficient to account for the formation of rain. The grand queſtion in this inquiry is, What becomes of the water that riſes in vapour into the atmoſphere? or what ſtate it ſubſiſts in there, between the time of its evaporation and its falling down again in rain? If it continues in the ſtate of watery vapour, or ſuch as is the immediate product of evaporation, it muſt poſſeſs the diſtinctive characters eſſential to that fluid: it muſt make the hygrometer move towards humidity, in proportion as the vapour is more or leſs abundant in the air: on a diminution of heat, the humidity, as ſhewn by the hygrometer, muſt increaſe; and on an increaſe of the heat the humidity muſt diminiſh; and the introduction of other hygroſcopic ſubſtances, drier than the air, muſt have the ſame effect as an augmentation of heat. Theſe are the properties of watery vapour, on every hypotheſis of evaporation; and therefore all the water that exiſts in the atmoſphere without poſſeſſing theſe properties, is no longer vapour, but muſt have changed its nature. M. de Luc ſhows, that the water which forms rain, though it has ever been conſidered and reaſoned upon as producing humidity, does not poſſeſs theſe properties, and muſt therefore have paſſed into another ſtate. See a full account of his reaſoning, and the ſteps by which he proceeded, in the article METEOROLOGY, n° 7, &c. As he thinks that the vapour paſſes into an inviſible ſtate in the interval between evaporation and its falling again in rain, and that in that ſtate it is not ſenſible to the hygrometer, he conſiders the laws of hygrology as inſufficient for explaining the formation of rain; but he does not pretend to have diſcovered the immediate cauſe of the formation of clouds and rain. If it is not in the immediate product of evaporation that rain has its ſource; if the vapours change their nature in the atmoſphere, ſo as no longer to be ſenſible to the hygrometer, or to the eye; if they do not become vapour again till clouds appear; and if, when the clouds are formed, no alteration is perceived in the quality of the air—we muſt acknowledge it to be very probable, that the intermediate ſtate of vapour is no other than air—and that the clouds do not proceed from any diſtinct fluid contained in the atmoſphere, but from a decompoſition of a part of the air itſelf, perfectly ſimilar to the reſt.

It appears, to us at leaſt, that M. de Luc's mode of reaſoning on this ſubject agrees better with the phenomena than Dr Hutton's. The Doctor, however, thinks differently, and publiſhed anſwers to the objections of M. de Luc with regard to his theory of rain; to which M. de Luc replied in a letter which was printed in the Appendix to the 81ſt volume of the Monthly Review: but it would extend our article beyond its due bounds, to give a view of this controverſy. See VAPOUR, WATER, WEATHER, and WIND.

As to the general quantity of rain that falls, and its proportion in ſeveral places at the ſame time, and in the ſame place at ſeveral times, we have many obſervations, journals, &c. in the Memoirs of the French Academy, the Philoſophical Tranſactions, &c. Upon meaſuring, then, the rain falling yearly, its depth, at a medium, and its proportion in ſeveral places, is found as in the following table:

	Inches.
At Townley, in Lancaſhire, obſerved by Mr Townley - - - -	42½
Upminſter, in Eſſex, by Dr Derham -	19¼
Zurich, in Swiſſerland, by Dr Scheuchzer	32¼
Piſa, in Italy, by Dr Mich. Ang. Tilli -	43¼
Paris, in France, by M. de la Hire -	19
Liſle, in Flanders, by M. de Vauban -	24

At Upminſter.			At Paris.	
1700	19 Inch.	.03	21 Inch.	.37
1701	18	.69	27	.77
1702	20	.38	17	.45
1703	23	.99	18	.51
1704	15	.80	21	.20
1705	16	.93	14	.82

From the Meteorological Journal of the Royal Society, kept by order of the Preſident and council, it appears that the whole quantity of rain at London, in each of the years ſpecified below, was as follows, viz.

			Inches.	
1774	-	-	26	.328
1775	-	-	24	.083
1776	-	-	20	.354
1777	-	-	25	.371
1778	-	-	20	.772
1779	-	-	26	.785
1780	-	-	17	.313

The quantity of rain in the four following years at London was,

			Inches.	
In 1789	-	-	21	.976
1790	-	-	16	.052
1791	-	-	15	.310
1792	-	-	19	.489

Proportion of the Rain of the ſeveral Seaſons to one another.

1708	Depth at Piſa. Inch.	Depth at Upminſ. Inch.	Depth at Zurich. Inch.	1708	Depth at Piſa. Inch.	Depth at Upminſ. Inch.	Depthat Zurich. Inch.
Jan.	6 .41	2 .88	1 .64	July	0 .00	1 .11	3 .50
Feb.	3 .28	0 .46	1 .65	Aug.	2 .27	2 .94	3 .15
Mar.	2 .65	2 .03	1 .51	Sept.	7 .21	1 .46	3 .02
Apr.	1 .25	0 .96	4 .69	Oct.	5 .33	0 .23	2 .44
May	3 .33	2 .02	1 .91	Nov.	0 .13	0 .86	0 .62
June	4 .90	2 .32	5 .91	Dec.	0 .00	1 .97	2 .62
Half Year	21 .82	10 .67	17 .31	Half Year	14 .94	8 .57	15 .35

See Philoſophical Tranſactions abridged, vol. iv. p. ii. p. 81, &c. and alſo Meteorological Journal of the Royal Society, publiſhed annually in the Philoſophical Tranſactions.

As to the uſe of rain, we may obſerve, that it moiſtens and ſoftens the earth, and thus fits it for affording nouriſhment to plants; by falling on high mountains, it carries down with it many particles of looſe earth, which ſerve to fertilize the ſurrounding valleys, and purifies the air from noxious exhalations, which tend in their return to the earth to meliorate the ſoil; it moderates the heat of the air; and is one means of ſupplying fountains and rivers. However, vehement rains in many countries are found to be attended with barrenneſs and poorneſs of the lands, and miſcarriage of the crops in the ſucceeding year: and the reaſon is plain; for theſe exceſſive ſtorms waſh away the fine mould into the rivers, which carry it into the ſea, and it is a long time before the land recovers itſelf again. The remedy to the famine, which ſome countries are ſubject to from this ſort of miſchief, is the planting large orchards and groves of ſuch trees as bear eſculent fruit; for it is an old obſervation, that in years, when grain ſucceeds worſt, theſe trees produce moſt fruit of all. It may partly be owing to the thorough moiſtening of the earth, as deep as their roots go by theſe rains, and partly to their trunks ſtopping part of light mould carried down by the rains, and by this means furniſhing themſelves with a coat of new earth.

Preternatural Rains. We have numerous accounts, in the hiſtorians of our own as well as other countries, of preternatural rains; ſuch as the raining of ſtones, of duſt, of blood, nay, and of living animals, as young frogs, and the like. We are not to doubt the truth of what thoſe who are authors of veracity and credit relate to us of this kind, ſo far as to ſuppoſe that the falling of ſtones and duſt never happened; the whole miſtake is, the ſuppoſing them to have fallen from the clouds: but as to the blood and frogs, it is very certain that they never fell at all, but the opinion has been a mere deception of the eyes. Men are extremely fond of the marvellous in their relations; but the judicious reader is to examine ſtrictly whatever is reported of this kind, and is not to ſuffer himſelf to be deceived.

There are two natural methods by which quantities of ſtones and duſt may fall in certain places, without their having been generated in the clouds or fallen as rain. The one is by means of hurricanes: the wind which we frequently ſee tearing off the tiles of houſes, and carying them to conſiderable diſtances, being equally able to take up a quantity of ſtones, and drop them again at ſome other place. But the other, which is much the moſt powerful, and probably the moſt uſual way, is for the eruptions of volcanoes and burning mountains to toſs up, as they frequently do, a vaſt quantity of ſtones, aſhes, and cinders, to an immenſe height in the air: and theſe, being hurried away by the hurricanes and impetuous winds which uſually accompany thoſe eruptions, and being in themſelves much lighter than common ſtones, as being half calcined, may eaſily be thus carried to vaſt diſtances; and there falling in places where the inhabitants know nothing of the occaſion, they cannot but be ſuppoſed by the vulgar to fall on them from the clouds. It is well known, that, in the great eruptions of Ætna and Veſuvius, ſhowers of aſhes, duſt, and ſmall cinders, have been ſeen to obſcure the air, and overſpread the ſurface of the ſea for a great way, and cover the decks of ſhips; and this at ſuch a diſtance, as it ſhould appear ſcarce conceivable that they ſhould have been carried to: and probably, if the accounts of all the ſhowers of theſe ſubſtances mentioned by authors be collected, they will all be found to have fallen within ſuch diſtances of volcanoes; and if compared as to the time of their falling, will be found to correſpond in that alſo wlth the eruptions of thoſe mountains. We have known inſtances of the aſhes from Veſuvius having been carried thirty, nay, ſorty leagues, and peculiar accidents may have carried them yet farther. It is not to be ſuppoſed that theſe ſhowers of ſtones and duſt fall for a continuance in the manner of ſhowers of rain, or that the fragments or pieces are as frequent as drops of water; it is ſufficient that a number of ſtones, or a quantity of duſt, fall at once on a place, where the inhabitants can have no knowledge of the part from whence they came, and the vulgar will not doubt their dropping from the clouds. Nay, in the canton of Berne in Swiſſerland, the inhabitants accounted it a miracle that it rained earth and ſulphur upon them at a time that a ſmall volcano terrified them; and even while the wind was ſo boiſterous, and hurricanes ſo frequent, that they ſaw almoſt every moment the duſt, ſand, and little ſtones torn up from the ſurface of the earth in whirlwinds, and carried to a conſiderable height in the air, they never conſidered that both the ſulphur thrown up by the volcano, and the duſt, &c. carried from their feet muſt fall ſoon after ſomewhere. It is very certain that in ſome of the terrible ſtorms of large hail, where the hail-ſtones have been of many inches round, on breaking them there have been found what people have called *ſtones in their middle*; but theſe obſervers needed only to have waited the diſſolving of one of theſe hail-ſtones, to have ſeen the ſtone in its centre diſunite alſo, it being only formed of the particles of looſe earthy matter, which the water, exhaled by the ſun's heat, had taken up in extremely ſmall moleculæ with it; and this only having ſerved to give an opake hue to the inner part of the congelation, to which the freezing of the water alone gave the apparent hardneſs of ſtone.

The raining of *blood* has been ever accounted a more terrible ſight and a more fatal omen than the other preternatural rains already mentioned. It is very certain that nature forms blood nowhere but in the veſſels of animals; and therefore ſhowers of it from the clouds are by no means to be credited. Thoſe who ſuppoſe that what has been taken for blood has been actually ſeen falling through the air, have had recourſe to flying inſects for its origin, and ſuppoſe it the eggs or dung of

Rain. Rain.

certain butterflies diſcharged from them as they were high up in the air. But it ſeems a very wild conjecture, as we know of no butterfly whoſe excrements or eggs are of ſuch a colour, or whoſe abode is ſo high, or their flocks ſo numerous, as to be the occaſion of this.

It is moſt probable that theſe bloody waters were never ſeen falling; but that people ſeeing the ſtanding waters blood-coloured, were aſſured, from their not knowing how it ſhould elſe happen, that it had rained blood into them. A very memorable inſtance of this there was at the Hague in the year 1670. Swammerdam, who relates it, tells us, that one morning the whole town was in an uproar on finding their lakes and ditches full of blood, as they thought; and having been certainly full of water the night before, they agreed it muſt have rained blood in the night: but a certain phyſician went down to one of the canals, and taking home a quantity of this blood-coloured water, he examined it by the microſcope, and found that the water was water ſtill, and had not at all changed its colour; but that it was full of prodigious ſwarms of ſmall red animals, all alive, and very nimble in their motions, whoſe colour and prodigious number gave a red tinge to the whole body of the water they lived in, on a leſs accurate inſpection. The certainty that this was the caſe, did not however perſuade the Hollanders to part with the miracle: they prudently concluded, that the ſudden appearance of ſuch a number of animals was as great a prodigy as the raining of blood would have been; and are aſſured to this day, that this portent foretold the ſcene of war and deſtruction which Louis XIV. afterwards brought into that country, which had before enjoyed 40 years uninterrupted peace.

The animals which thus colour the water of lakes and ponds are the *pulices arboreſcentes* of Swammerdam, or the water-fleas with branched horns. Theſe creatures are of a reddiſh-yellow or flame colour: they live about the ſides of ditches, under weeds, and among the mud; and are therefore the leſs viſible, except at a certain time, which is in the end or beginning of June: it is at this time that theſe little animals leave their receſſes to float looſe above the water, to meet for the propagation of their ſpecies, and by that means become viſible in the colour they give the water. This is viſible, more or leſs, in one part or other of almoſt all ſtanding waters at this ſeaſon; and it is always at this ſeaſon that the bloody waters have alarmed the ignorant. See *Pulex Monoculus*.

The raining of *frogs* is a thing not leſs wonderful in the accounts of authors who love the marvellous, than thoſe of blood or ſtones; and this is ſuppoſed to happen ſo often, that there are multitudes who pretend to have been eye-witneſſes of it. Theſe rains of frogs always happen after very dry ſeaſons, and are much more frequent in the hotter countries than in the cold ones. In Italy they are very frequent; and it is not uncommon to ſee the ſtreets of Rome ſwarming both with young frogs and toads in an inſtant in a ſhower of rain; they hopping everywhere between the people's legs as they walk, though there was not the leaſt appearance of them before. Nay, they have been ſeen to fall through the air down upon the pavements. This ſeems a ſtrong circumſtance in favour of their being rained down from the clouds; but, when ſtrictly examined, it comes to nothing: for theſe frogs that are ſeen to fall, are always found dead, lamed, or bruiſed by the fall, and never hop about as the reſt; and they are never ſeen to fall, except cloſe under the walls of houſes, from the roofs and gutter of which they have accidentally ſlipped down. Some people, who love to add to ſtrange things yet ſtranger, affirm that they have had the young frogs fall into their hats in the midſt of an open field; but this is idle, and wholly falſe.

Others, who cannot agree to their falling from the clouds, have tried to ſolve the difficulty of their ſudden appearance, by ſuppoſing them hatched out of the egg, or ſpawn, by theſe rains. Nay, ſome have ſuppoſed them made immediately out of the duſt: but there are unanſwerable arguments againſt all theſe ſuppoſitions. Equivocal generation, or the ſpontaneous production of animals out of duſt, is now wholly exploded. The fall from the clouds muſt deſtroy and kill theſe tender and ſoft-bodied animals: and they cannot be at this time hatched immediately out of eggs; becauſe the young frog does not make its appearance from the egg in form, but has its hinder legs enveloped in a ſkin, and is what we call a *tadpole;* and the young frogs are at leaſt 100 times larger at the time of their appearance, than the egg from which they ſhould be hatched.

It is beyond a doubt, that the frogs which make their appearance at this time, were hatched and in being long before: but that the dry ſeaſons had injured them, and kept them ſluggiſhly in holes or coverts; and that all the rain does, is the enlivening them, giving them new ſpirits, and calling them forth to ſeek new habitations, and enjoy the element they were deſtined in great part to live in. Theophraſtus, the greateſt of all the naturaliſts of antiquity, has affirmed the ſame thing. We find that the error of ſuppoſing theſe creatures to fall from the clouds was as early as that author's time; and alſo that the truth, in regard to their appearance, was as early known; though, in the ages ſince, authors have taken care to conceal the truth, and to hand down to us the error. We find this venerable ſage, in a fragment of his on the generation of animals which appear on a ſudden, bantering the opinion, and aſſerting that they were hatched and living long before. The world owes, however, to the accurate Signior Redi the great proof of this truth, which Theophraſtus only has affirmed: for this gentleman, diſſecting ſome of theſe new-appearing frogs, found in their ſtomachs herbs and other half-digeſted food; and, openly ſhowing this to his credulous countrymen, aſked them whether they thought that nature, which engendered, according to their opinion, theſe animals in the clouds, had alſo been ſo provident as to engender graſs there for their food and nouriſhment?

To the raining of frogs we ought to add the raining of *graſshoppers* and *locuſts*, which have ſometimes appeared in prodigious numbers, and devoured the fruits of the earth. There has not been the leaſt pretence for the ſuppoſing that theſe animals deſcended from the clouds, but that they appeared on a ſudden in prodigious numbers. The naturaliſt, who knows the many accidents attending the eggs of theſe and other the like animals, cannot but know that ſome ſeaſons will prove particularly favourable to the hatching them, and the prodigious number of eggs that many inſects lay could not but every year bring us ſuch abundance of the young, were they not liable to many accidents, and had not provident nature taken care, as in many plants, to continue the ſpecies by a very numerous ſtock of ſeeds, of which perhaps not one in 500 need take root in order to continue an equal number of plants. As it is thus alſo in regard to inſects, it cannot but happen, that if a favourable ſeaſon encourage the hatching of all thoſe eggs, a very ſmall number of which alone were neceſſary to continue the ſpecies, we muſt, in ſuch ſeaſons, have a proportionate abundance of them. There appeared about 50 years ago, in London, ſuch a prodigious ſwarm of the little beetle we call the *lady-cow*, that the very poſts in the ſtreets were everywhere covered with them. But thanks to the progreſs of philoſophy among us, we had no body to aſſert that it rained cow-ladies, but contented ourſelves with ſaying that it had been a favourable ſeaſon for their eggs. The prodigious number of a ſort of grub which did vaſt miſchief about the ſame period among the corn and graſs by eating off their roots, might alſo have been ſuppoſed to proceed from its having rained grubs by people fond of making every thing a prodigy; but our knowledge in natural hiſtory aſſured us, that theſe were only the hexapode worms of the common hedge-beetle called the *cock-chafer*.

The raining of *fiſhes* has been a prodigy alſo much talked of in France, where the ſtreets of a town at ſome diſtance from Paris, after a terrible hurricane in the night, which tore up trees, blew down houſes, &c. were found in a manner covered with fiſhes of various ſizes. Nobody here made any doubt of theſe having fallen from the clouds; nor did the abſurdity of fiſh, of five or ſix inches long, being generated in the air, at all ſtartle the people, or ſhake their belief in the miracle, till they found, upon inquiry, that a very well-ſtocked fiſh-pond, which ſtood on an eminence in the neighbourhood, had been blown dry by the hurricane, and only the great fiſh left at the bottom of it, all the ſmaller fry having been toſſed into their ſtreets.

Upon the whole, all the ſuppoſed marvellous rains have been owing to ſubſtances naturally produced on the earth, and either never having been in the air at all, or only carried thither by accident.

In Sileſia, after a great dearth of wheat in that country, there happened a violent ſtorm of wind and rain, and the earth was afterwards covered, in many places, with ſmall round ſeeds. The vulgar cried out that Providence had ſent them food, and that it had rained *millet*: but theſe were, in reality, only the ſeeds of a ſpecies of veronica, or ſpeed-well, very common in that country; and whoſe ſeeds being juſt ripe at that time, the wind had diſlodged them from their capſules, and ſcattered them about. In Britain, we have hiſtories of rains of this marvellous kind, but all fabulous. It was once ſaid to rain *wheat* in Wiltſhire; and the people were all alarmed at it as a miracle, till Mr Cole ſhowed them, that what they took for wheat was only the ſeeds or kernels of the berries of ivy, which being then fully ripe, the wind had diſlodged from the ſides of houſes, and trunks of trees, on which the ivy that produced them crept.

And we even once had a raining of fiſhes near the coaſt of Kent in a terrible hurricane, with thunder and lightning. The people who ſaw ſmall ſprats ſtrewed all about afterwards, would have it that they had fallen from the clouds; but thoſe who conſidered how far the high winds have been known to carry the ſea-water, did not wonder that they ſhould be able to carry ſmall fiſh with it ſo ſmall a part of the way.

In the Philoſophical Tranſactions for 1782 we have the following account of a preternatural kind of rain by Count de Gioeni: "The morning of the 24th inſtant there appeared here a moſt ſingular phenomenon. Every place expoſed to the air was found wet with a coloured cretaceous grey water, which, after evaporating and filtrating away, left every place covered with it to the height of two or three lines; and all the iron-work that was touched by it became ruſty.

"The public, inclined to the marvellous, fancied various cauſes of the rain, and began to fear for the animals and vegetables.

"In places where rain-water was uſed, they abſtained from it: ſome ſuſpecting vitriolic principles to be mixed with it, and others predicting ſome epidemical diſorder.

"Thoſe who had obſerved the exploſions of Etna 20 days and more before, were inclined to believe it originated from one of them.

"The ſhower extended from N. ¼ N.E. to S. ¼ S.W. over the fields, about 70 miles in a right line from the vertex of Etna.

"There is nothing new in volcanos having thrown up ſand, and alſo ſtones, by the violent expanſive force generated within them, which ſand has been carried by the wind to diſtant regions.

"But the colour and ſubtility of the matter occaſioned doubts concerning its origin; which increaſed from the remarkable circumſtance of the water in which it came incorporated; for which reaſons ſome other principle or origin was ſuſpected.

"It became, therefore, neceſſary by all means to aſcertain the nature of this matter, in order to be convinced of its origin, and of the effects it might produce. This could not be done without the help of a chemical analyſis. To do this then with certainty, I endeavoured to collect this rain from places where it was moſt probable no heterogeneous matter would be mixed with it. I therefore choſe the plant called *braſſica capitata*, which having large and turned-up leaves, they contained enough of this coloured water: many of theſe I emptied into a veſſel, and left the contents to ſettle till the water became clear.

"This being ſeparated into another veſſel, I tried it with vegetable alkaline liquors and mineral acids; but could obſerve no decompoſition by either. I then evaporated the water in order to reunite the ſubſtances that might be in ſolution; and touching it again with the aforeſaid liquors, it ſhowed a ſlight efferveſcence with the acids. When tried with the ſyrup of violets, this became a pale green; ſo that I was perſuaded it contained a calcareous ſalt. With the decoction of galls no precipitation was produced.

"The matter being afterwards dried in the ſhade, it appeared a very ſubtile fine earth, of a cretaceous colour, but inert, from having been diluted by the rain.

"I next thought of calcining it with a ſlow fire, and it aſſumed the colour of a brick. A portion of this being put into a crucible, I applied to it a ſtronger heat; by which it loſt almoſt all its acquired colour. Again, I expoſed a portion of this for a longer time to a very violent heat (from which a vitrification might be

expected);

Rain, Rainbow.

expected); it remained, however, quite ſoft, and was eaſily bruiſed, but returned to its original duſky colour.

“ From the moſt accurate obſervations of the ſmoke from the three calcinations, I could not diſcover either colour or ſmell that indicated any arſenical or ſulphureous mixture.

“ Having therefore calcined this matter in three portions, with three different degrees of fire, I preſented a good magnet to each: it did not act either on the firſt or ſecond; a ſlight attraction was viſible in many places on the third: this perſuaded me, that this earth contains a martial principle in a metallic form, and not in a vitriolic ſubſtance.

“ The nature of theſe ſubſtances then being diſcovered, their volcanic origin appears; for iron, the more it is expoſed to violent calcination, the more it is divided by the loſs of its phlogiſtic principle; which cannot naturally happen but in the great chimney of a volcano. Calcareous ſalt, being a marine ſalt combined with a calcareous ſubſtance by means of violent heat, cannot be otherwiſe compoſed than in a volcano.

“ As to their dreaded effects on animals and vegetables, every one knows the advantageous uſe, in medicine, both of the one and the other, and this in the ſame form as they are thus prepared in the great laboratory of nature.

“ Vegetables, even in flower, do not appear in the leaſt macerated, which has formerly happened from only ſhowers of ſand.

“ How this volcanic production came to be mixed with water may be conceived in various ways.

“ Ætna, about its middle regions, is generally ſurrounded with clouds that do not always riſe above its ſummit, which is 2900 paces above the level of the ſea. This matter being thrown out, and deſcending upon the clouds below it, may happen to mix and fall in rain with them in the uſual way. It may alſo be conjectured, that the thick ſmoke which the volcanic matter contained might, by its rarefaction, be carried in the atmoſphere by the winds over that tract of country; and then cooling ſo as to condenſe and become ſpecifically heavier than the air, might deſcend in that coloured rain.

“ I muſt, however, leave to philoſophers (to whom the knowledge of natural agents belongs) the examination and explanation of ſuch phenomena, confining myſelf to obſervation and chemical experiments.”

Rain, a well built and fortified town of Bavaria, one of the keys of this electorate, on the Lech, 20 miles weſt of Ingolſtadt. N. Lat. 48. 51. E. Long. 11. 12.

Rain-Bird. See Cuculus, n° 8.

RAINBOW. See Optics, Part II. Sect. i. § 1.

In the Philoſophical Tranſactions for 1793, we have the following account of two rainbows ſeen by the Rev. Mr Sturges.

“ On the evening of the 9th of July 1792, between ſeven and eight o'clock, at Alverſtoke, near Goſport, on the ſea-coaſt of Hampſhire, there came up, in the ſouth-eaſt, a cloud with a thunder-ſhower; while the ſun ſhone bright, low in the horizon to the north-weſt.

Plate cccxxvii. fig. 2.

“ In this ſhower two primary rainbows appeared, AB and AC, not concentric, but touching each other at A, in the ſouth part of the horizon; with a ſecondary bow to each, DE and DF (the laſt very faint but diſcernible), which touched likewiſe at D. Both the primary were very vivid for a conſiderable time, and at different times nearly equally ſo; but the bow AB was moſt permanent, was a larger ſegment of a circle, and at laſt, after the other had vaniſhed, became almoſt a ſemicircle; the ſun being near ſetting. It was a perfect calm, and the ſea was as ſmooth as glaſs.

Rainbow.

“ If I might venture to offer a ſolution of this appearance, it would be as follows. I conſider the bow AB as the true one, produced by the ſun itſelf; and the other, AC, as produced by the reflection of the ſun from the ſea, which, in its perfectly ſmooth ſtate, acted as a ſpeculum. The direction of the ſea, between the Iſle of Wight and the land, was to the north-weſt in a line with the ſun, as it was then ſituated. The image reflected from the water, having its rays iſſuing from a point lower than the real ſun, and in a line coming from beneath the horizon, would conſequently form a bow higher than the true one AB. And the ſhores, by which that narrow part of the ſea is bounded, would before the ſun's actual ſetting intercept its rays from the ſurface of the water, and cauſe the bow AC, which I ſuppoſe to be produced by the reflection, to diſappear before the other.”

The marine or ſea bow is a phenomenon which may be frequently obſerved in a much agitated ſea, and is occaſioned by the wind ſweeping part of the waves, and carrying them aloft; which when they fall down are refracted by the ſun's rays, which paint the colours of the bow juſt as in a common ſhower. Theſe bows are often ſeen when a veſſel is ſailing with conſiderable force, and daſhing the waves around her, which are raiſed partly by the action of the ſhip and partly by the force of the wind, and, falling down, they form a rainbow; and they are alſo often occaſioned by the daſhing of the waves againſt the rocks on ſhore.

In the Philoſophical Tranſactions, it is obſerved by F. Bourzes, that the colours of the marine rainbow are leſs lively, leſs diſtinct, and of ſhorter continuance, than thoſe of the common bow; that there are ſcarce above two colours diſtinguiſhable, a dark yellow on the ſide next the ſun, and a pale green on the oppoſite ſide. But they are more numerous, there being ſometimes 20 or 30 ſeen together.

To this claſs of bows may be referred a kind of white or colourleſs rainbows, which Mentzelius and others affirm to have ſeen at noon-day. M. Marlotte, in his fourth *Eſſai de Phyſique*, ſays, theſe bows are formed in miſts, as the others are in ſhowers; and adds, that he has ſeen ſeveral both after ſun-riſing and in the night. The want of colour he attributes to the ſmallneſs of the vapours which compoſe the miſt; but perhaps it is rather from the exceeding tenuity of the little veſiculæ of the vapour, which being only little watery pellicles bloated with air, the rays of light undergo but little refraction in paſſing out of air into them; too little to ſeparate the differently coloured rays, &c. Hence the rays are reflected from them, compounded as they came, that is, white. Rohault mentions * coloured rainbows on the graſs; formed by the refractions of the ſun's rays in the morning dew. Rainbows have been alſo produced by the reflection of the ſun from a river; and in the Philoſophical Tranſactions, Vol. L. p. 294. we have an account of a rainbow, which muſt have been formed by the exhalations from the city of London, when the ſun had been ſet 20 minutes, and conſequently the centre of the bow was above the horizon. The colours were the ſame as in the common rainbow, but fainter.

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* Trait. de Phyſique.

It has often been made a ſubject of inquiry among the curious how there came to be no rainbow before the flood, which is thought by ſome to have been the caſe from its being made a ſign of the covenant which the Deity was pleaſed to make with man after that event. Mr Whitehurſt, in his *Inquiry into the Original State and Formation of the Earth*, p. 173, &c. endeavours to eſtabliſh it as a matter of great probability at leaſt, that the antediluvian atmoſphere was ſo uniformly temperate as never to be ſubject to ſtorms, tempeſts, or rain, and of courſe it could never exhibit a rainbow. For our own part, we cannot ſee how the earth at that period could do without rain any more than at preſent; and it appears to us from Scripture equally probable that the rainbow was ſeen before the flood as after it. It was then, however, made a token of a certain covenant; and it would unqueſtionably do equally well for that purpoſe if it had exiſted before as if it had not.

Lunar RAINBOW. The moon ſometimes alſo exhibits the phenomenon of an iris or rainbow by the refraction of her rays in drops of rain in the night-time. This phenomenon is very rare. In the Philoſophical Tranſactions for 1783, however, we have an account of three ſeen in one year, and all in the ſame place, communicated in two letters by Marmaduke Tunſtall, Eſq. The firſt was ſeen 27th February 1782, at Greta Bridge, Yorkſhire, between ſeven and eight at night, and appeared "in tolerably diſtinct colours, ſimilar to a ſolar one, but more faint: the orange colour ſeemed to predominate. It happened at full moon; at which time alone they are ſaid to have been always ſeen. Though Ariſtotle is ſaid to have obſerved two, and ſome others have been ſeen by Suellius, &c. I can only find two deſcribed with any accuracy; viz. one by Plot, in his Hiſtory of Oxfordſhire, ſeen by him in 1675, though without colours; the other ſeen by a Derbyſhire gentleman at Glapwell, near Cheſterfield, deſcribed by Thoreſby, and inſerted in N° 331. of the Philoſophical Tranſactions: this was about Chriſtmas, 1710, and ſaid to have had all the colours of the Iris Solaris. The night was windy; and though there was then a drizzling rain and dark cloud, in which the rainbow was reflected, it proved afterwards a light froſt."

Two others were afterwards ſeen by Mr Tunſtall; one on July the 30th, about 11 o'clock, which laſted about a quarter of an hour, without colours. The other, which appeared on Friday October 18. was "perhaps the moſt extraordinary one of the kind ever ſeen. It was firſt viſible about nine o'clock, and continued, tho' with very different degrees of brilliancy, till paſt two. At firſt, though a ſtrongly marked bow, it was without colours; but afterwards they were very conſpicuous and vivid in the ſame form as in the ſolar, though fainter; the red, green, and purple, were moſt diſtinguiſhable. About twelve it was the moſt ſplendid in appearance; its arc was conſiderably a ſmaller ſegment of a circle than a ſolar; its ſouth-eaſt limb firſt began to fail, and a conſiderable time before its final extinction: the wind was very high, nearly due weſt, moſt part of the time, accompanied with a drizzling rain. It is a ſingular circumſtance, that three of theſe phenomena ſhould have been ſeen in ſo ſhort a time in one place, as they have been eſteemed ever ſince the time of Ariſtotle, who is ſaid to have been the firſt obſerver of them, and ſaw only two in 50 years, and ſince by Plot and Thoreſby, almoſt the only two Engliſh authors who have ſpoken of them, to be exceeding rare. They ſeem evidently to be occaſioned by a refraction in a cloud or turbid atmoſphere, and in general are indications of ſtormy and rainy weather: ſo bad a ſeaſon as the late ſummer having, I believe, ſeldom occurred in England. Thoreſby, indeed, ſays, the one he obſerved was ſucceeded by ſeveral days of fine ſerene weather. One particular, rather ſingular, in the ſecond, viz. of July the 30th, was its being ſix days after the full of the moon; and the laſt, though of ſo long a duration, was three days before the full: that of the 27th of February was exactly at the full, which uſed to be judged the only time they could be ſeen, though in the Encyclopedia there is an account that Weidler obſerved one in 1719, in the firſt quarter of the moon, with faint colours, and in very calm weather. No lunar iris, I ever heard or read of, laſted near ſo long as that on the 18th inſtant, either with or without colours."

In the Gentleman's Magazine for Auguſt 1788 we have an account of a lunar rainbow by a correſpondent who ſaw it. "On Sunday evening the 17th of Auguſt (ſays he), after two days, on both of which, particularly the former, there had been a great deal of rain, together with lightning and thunder, juſt as the clocks were ſtriking nine, 23 hours after full moon, looking through my window, I was ſtruck with the appearance of ſomething in the ſky, which ſeemed like a rainbow. Having never ſeen a rainbow by night, I thought it a very extraordinary phenomenon, and haſtened to a place where there were no buildings to obſtruct my view of the hemiſphere: here I found that the phenomenon was no other than a lunar rainbow; the moon was truly 'walking in brightneſs,' brilliant as ſhe could be; not a cloud was to be ſeen near her; and over-againſt her, toward the north-weſt, or perhaps rather more to the north, was a rainbow, a vaſt arch, perfect in all its parts, not interrupted or broken as rainbows frequently are, but unremittedly viſible from one horizon to the other. In order to give ſome idea of its extent, it is neceſſary to ſay, that as I ſtood toward the weſtern extremity of the pariſh of Stoke Newington, it ſeemed to take its riſe from the weſt of Hampſtead, and to the end, perhaps, in the river Lea, the eaſtern boundary of Tottenham; its colour was white, cloudy, or greyiſh, but a part of its weſtern leg ſeemed to exhibit tints of a faint ſickly green. I continued viewing it for ſome time, till it began to rain; and at length the rain increaſing, and the ſky growing more hazy, I returned home about a quarter or 20 minutes paſt nine, and in ten minutes came out again; but by that time all was over, the moon was darkened by clouds, and the rainbow of courſe vaniſhed."

Marine RAINBOW, or *Sea-bow*. See the article RAINBOW.

RAINBOW-*Stone*. See MOON-*Stone*.

RAISINS, grapes prepared by ſuffering them to remain on the vine till they are perfectly ripe, and then drying them in the ſun, or by the heat of an oven.

The difference between raiſins dried in the ſun, and thoſe dried in ovens, is very obvious: the former are ſweet and pleaſant, but the latter have a latent acidity with the ſweetneſs that renders them much leſs agreeable.

The common way of drying grapes for raiſins, is to tie two or three bunches of them together while yet on the vine, and dip them into a hot lixivium of wood-aſhes, with a little of the oil of olives in it. This diſpoſes them to ſhrink and wrinkle; and after this they are left on the vine three or four days ſeparated on ſticks in an horizontal ſituation, and then dried in the ſun at leiſure, after being cut from the tree. The fineſt and beſt raiſins are thoſe called in ſome places *Damaſcus* and *Jube raiſins*; which are diſtinguiſhed from the others by their ſize and figure: they are flat and wrinkled on the ſurface, ſoft and juicy within, and near an inch long; and, when freſh and growing on the bunch, are of the ſize and ſhape of a large olive.

The raiſins of the ſun, and jar-raiſins, are all dried by the heat of the ſun; and theſe are the ſorts uſed in medicine. However, all the kinds have much the ſame virtues: they are all nutritive and balſamic; they are allowed to be attenuant, are ſaid to be good in nephritic complaints, and are an ingredient in pectoral decoctions: in which caſes, as alſo in all others where aſtringency is not required of them, they ſhould have the ſtones carefully taken out.

Raisin-Wine. See Wine.

RAKKATH (anc. geog.), a town of Upper Galilee, thought to be Tiberias, (Talmud): but this is denied by Reland, who ſays that Rakkath was a town of the tribe of Napthali.

RAKE is a well known inſtrument with teeth, by which the ground is divided. See Agriculture, p. 318.

Rake alſo means a looſe, diſorderly, vicious, and thoughtleſs fellow.

Rake of a Ship, is all that part of her hull which hangs over both ends of her keel. That which is before is called the *fore rake*, or *rake forward*, and that part which is at the ſetting on of the ſtern-poſt is called the *rake-aſt*, or *afterward*.

RALEIGH (Sir Walter), fourth ſon of Walter Raleigh, Eſq; of Fardel, in the pariſh of Cornwood in Devonſhire, was born in 1552 at Hayes, in the pariſh of Budley, a farm belonging to his father. About the year 1568, he was ſent to Oriel college in Oxford, where he continued but a ſhort time; for in the following year he embarked for France, being one of the hundred volunteers, commanded by Henry Champernon, who, with other Engliſh troops, were ſent by queen Elizabeth to aſſiſt the queen of Navarre in defending the Proteſtants. In this ſervice he continued for five or ſix years; after which he returned to London, and probably reſided in the Middle Temple. But his enterpriſing genius would not ſuffer him to remain long in a ſtate of inactivity. In 1577 or 1578, he embarked for the Low Countries with the troops ſent by the queen to aſſiſt the Dutch againſt the Spaniards, and probably ſhared the glory of the deciſive victory over Don John of Auſtria in 1578. On his return to England, a new enterpriſe engaged his attention. His half-brother, Sir Humphrey Gilbert, having obtained a patent to plant and inhabit ſome parts of North America, Mr Raleigh embarked in this adventure; but, meeting with a Spaniſh fleet, after a ſmart engagement they returned, without ſucceſs, in 1579.

The following year, the king of Spain, in conjunction with the pope, having projected a total conqueſt of the Engliſh dominions, ſent troops to Ireland to aſſiſt the Deſmonds in the Munſter rebellion. Raleigh obtained a captain's commiſſion under Lord Grey of Wilton, then deputy of Ireland, and embarked for that kingdom; where, by his conduct and reſolution, he was principally inſtrumental in putting an end to the rebellious attempt. He returned to England; and attracted the notice of queen Elizabeth, owing, as we are told in Naunton's *Fragmenta Regalia*, to the following accidental piece of gallantry. The queen, as ſhe was one day taking a walk, being ſtopped by a *ſplaſhy* place in the road, our gallant young ſoldier took off his new pluſh mantle, and ſpread it on the ground. Her majeſty trod gently over the fair foot-cloth, ſurpriſed and pleaſed with the adventure. He was a handſome man, and remarkable for his gentility of addreſs.

The queen admitted him to her court, and employed him firſt as an attendant on the French ambaſſador Simier on his return home, and afterward to eſcort the duke of Anjou to Antwerp. During this excurſion he became perſonally known to the prince of Orange; from whom, at his return, he brought ſpecial acknowledgments to the queen, who now frequently converſed with him. But the inactive life of a courtier did not ſuit the enterpriſing ſpirit of Mr Raleigh. In the year 1583, he embarked with his brother, Sir Humphrey Gilbert, on a ſecond expedition to Newfoundland, in a ſhip called the *Raleigh*, which he built at his own expence; but was obliged to return on account of an infectious diſtemper on board. He was, however, ſo little affected by this diſappointment, that he now laid before the queen and council a propoſal for exploring the continent of North America; and in 1584 obtained a patent empowering him to poſſeſs ſuch countries as he ſhould diſcover in that part of the globe. Accordingly Mr Raleigh fitted out two ſhips at his own expence, which ſailed in the month of April, and returned to England about the middle of September, reporting that they had diſcovered and taken poſſeſſion of a fine country called *Windangocoa*, to which the queen gave the name of *Virginia*. About this time he was elected knight of the ſhire for the county of Devon, and ſoon after received the honour of knighthood; and to enable him to carry on his deſigns abroad, the queen granted him a patent for licenſing the venders of wine throughout the kingdom. In 1585 he ſent a fleet of ſeven ſhips to Virginia, commanded by his relation Sir Richard Grenville, who left a colony at Roanah of 107 perſons, under the government of Mr Lane; and by the eſtabliſhment of this colony he firſt imported tobacco into England. See Nicotiana. In the ſame year Sir Walter Raleigh obtained a grant of 12,000 acres of the forfeited lands in the county of Cork in Ireland.—About the ſame time he was made ſeneſchal of the duchy of Cornwall, and warden of the ſtanneries; and grew into ſuch favour with the queen, that even Leiceſter was jealous of his influence.

In 1587, he ſent another colony of 150 men to Virginia, with a governor, Mr John White, and 12 aſſiſtants. About this time we find our knight diſtinguiſhed by the titles of *Captain of the queen's guards*, and *Lieutenant general of Cornwall*. From this period to the year 1594, he was continually engaged in projecting new expeditions, ſending ſuccours to colonies abroad, defending the kingdom from the inſults of the Spaniards, and tranſacting parliamentary, buſineſs, with equal ability and reſolution. Whilſt thus employed, he was publicly charged, in a libel written by the infamous Jeſuit Parſons, with being an Atheiſt; a groundleſs and ridiculous imputation. In 1594, he obtained from the queen a grant of the manor of Sherborne in Dorſetſhire, where he built a magnificent houſe: but Sir Walter fell under the queen's diſpleaſure on account of an intrigue with the daughter of Sir Nicholas Throgmorton, one of the maids of honour; however, he married the lady, and lived with her in great conjugal harmony. During his diſgrace at court, he projected the conqueſt of Guiana in South America, and in 1595 ſailed for that country; of which having taken poſſeſſion, after defeating the Spaniards who were ſettled there, he returned to England the ſame year, and ſoon after publiſhed an account of his expedition. In the following year he was one of the admirals in the ſucceſsful expedition againſt Cadiz, under the command of Howard and the earl of Eſſex; and in 1597 he ſailed with the ſame commanders againſt the Azores. Soon after theſe expeditions, we find him aſſiduouſly engaged in parliamentary buſineſs, and a diſtinguiſhed perſonage in jouſts and tournaments. In 1600 he was ſent on a joint embaſſy with Lord Cobham to Flanders, and at his return made governor of Jerſey.

Queen Eliſabeth died in the beginning of the year 1603; and with her Raleigh's glory and felicity ſunk, never to riſe again. Upon the acceſſion of James, Sir Walter loſt his intereſt at court, was ſtripped of his preferments, and accuſed of a plot againſt the king. He was arraigned at Wincheſter, and, on his trial, inſulted by the moſt ſhocking brutality by the famous Coke, attorney-general, whoſe ſophiſtical vociferation influenced the jury to convict him without the leaſt proof of guilt. After a month's impriſonment, however, in daily expectation of his execution, he was reprieved, and ſent to the Tower; and his eſtates were given to Car, earl of Somerſet, the king's favourite. During this confinement, he wrote many of his moſt valuable pieces, particularly his Hiſtory of the World. In March 1615, after 16 years impriſonment, he obtained his liberty, and immediarely began to prepare for another voyage to Guiana. In Auguſt 1616, the king granted him a very ample commiſſion for that purpoſe; and in July the year following, he ſailed from Plymouth: but, ſtrange as it may appear, it is moſt certain that the whole ſcheme was revealed to the Spaniards by the king himſelf, and thus neceſſarily rendered abortive.

He returned to England in 1618, where he was ſoon after ſeized, impriſoned, and beheaded; not for any pretended miſdemeanor on the late expedition, but in conſequence of his former attainder. The truth of the matter is, he was ſacrificed by the puſillanimous monarch to appeaſe the Spaniards; who, whilſt Raleigh lived, thought every part of their dominions in danger. He was executed in Old Palace Yard, and buried in St Margaret's adjoining, in the 66th year of his age. His behaviour on the ſcaffold was manly, unaffected, cheerful, and eaſy. Being aſked by the executioner which way he would lay his head, he anſwered, "So the heart be right, it is no matter which way the head lies." He was a man of admirable parts, extenſive knowledge, undaunted reſolution, and ſtrict honour and honeſty. He was the author of a great many works, ſome of which have not been printed.

RALLUS, the Rail, in ornithology; a genus belonging to the order of grallæ. The beak is thickeſt at the baſe, compreſſed, equal, acute, and ſomewhat ſharp on the back near the point; the noſtrils are oval; the feet have four toes, without any web; and the body is compreſſed. Mr Latham, in his *Index Ornithologicus*, enumerates 24 ſpecies, beſides ſome varieties. They are chiefly diſtinguiſhed by their colour. "Theſe birds (ſays Buffon) conſtitute a large family, and their habits are different from thoſe of the other ſhore-birds, which reſide on ſands and gravel. The rails, on the contrary, inhabit only the ſlimy margins of pools and rivers, eſpecially low grounds covered with flags and other large marſh plants. This mode of living is habitual and common to all the ſpecies of water-rails. The land rail frequents meadows, and from the diſagreeable cry, or rather rattling in the throat of this bird, is derived the generic name. In all the rails, the body is ſlender, and ſhrunk at the ſides; the tail extremely ſhort; the head ſmall; the bill pretty like that of the gallinaceous kind, though much longer, and not ſo thick; a portion of the leg above the knee is bare; the three fore-toes without membranes, and very long: they do not, like other birds, draw their feet under their belly in flying, but allow them to hang down: their wings are ſmall and very concave, and their flight is ſhort.—They ſeem to be more diffuſed than varied; and nature has produced or tranſported them over the moſt diſtant lands. Captain Cook found them at the Straits of Magellan; in different iſlands of the ſouthern hemiſphere, at Anamoka, at Tanna, and at the iſle of Norfolk. In the Society Iſlands there are two ſpecies of rails; a little black ſpotted one, *(pooa-nèe)*, and a little red-eyed one *(mai-ho)*. It appears that the two acolins of Fernandez, which he denominates *water-quails*, are of a ſpecies of rails peculiar to the great lake of Mexico.—The colins, which might be confounded with theſe, are a kind of partridges." The principal are,

1. The aquaticus, or water-rail, is a bird of a long ſlender body, with ſhort concave wings. It delights leſs in flying than running: which it does very ſwiftly along the edges of brooks covered with buſhes: as it runs, it every now and then flirts up its tail, and in flying hangs down its legs; actions it has in common with the water-hen. Its weight is four ounces and a half. The length to the end of the tail is 12 inches; the breadth 16. The bill is ſlender, ſlightly incurvated, one inch three quarters long: the upper mandible black, edged with red; the lower, orange-coloured: the head, hind part of the neck, the back, and coverts of the wings and tail, are black, edged with an olive brown; the throat, breaſt, and upper part of the belly, are aſh-coloured: the ſides under the wings as far as the rump, finely varied with black and white bars. The tail is very ſhort, conſiſts of 12 black feathers; the ends of the two middle tipt with ruſt colour; the feathers immediately beneath the tail white. The legs are placed far behind, and are of a duſky fleſh-colour. The toes very long, and divided to their very origin; though the feet are not webbed, it takes the water; will ſwim on it with much eaſe, but is often obſerved

Rallus.

to run along the ſurface. "Water rails (ſays Buffon) are ſeen near the perennial fountains during the greateſt part of the winter, yet like the land rails they have their regular migrations. They paſs Malta in the ſpring and autumn. The Viſcount de Querhoent ſaw ſome 50 leagues off the coaſts of Portugal on the 17th of April. They were ſo fatigued, that they ſuffered themſelves to be caught by the hand (A). Gmelin found theſe birds in the countries watered by the Don. Belon calls them *black rails*, and ſays they are every where known, and that the ſpecies is more numerous than the red rail, or land rail. The fleſh of the water rail is not ſo delicate as that of the land rail, and has even a marſhy taſte, nearly like that of the gallinule. It continues the whole year in England."

2. The porzana, or gallinule, is not very frequent in Great Britain, and is ſaid to be migratory. Inhabits the ſides of ſmall ſtreams, concealing itſelf among the buſhes. Its length is nine inches; its breadth, 15; its weight, four ounces five drachms. The head is brown, ſpotted with black; the neck a deep olive, ſpotted with white: the feathers of the back are black next their ſhafts, then olive-coloured, and edged with white; the ſcapulars are olive, finely marked with two ſmall white ſpots on each web: the legs of a yellowiſh green. "Its habits (ſays Buffon) wild, its inſtinct ſtupid, the porzana is unſuſceptible of education, nor is even capable of being tamed. We raiſed one, however, which lived a whole ſummer on crumbs of bread and hempſeed; when by itſelf, it kept conſtantly in a large bowl of water; but if a perſon entered the cloſet where it was ſhut, it ran to conceal itſelf in a ſmall dark corner, without venting cries or murmurs. In the ſtate of liberty, however, it has a ſharp piercing voice, much like the ſcream of a young bird of prey; and though it has no propenſity to ſociety, as ſoon as one cries, another repeats the ſound, which is thus conveyed through all the reſt in the diſtrict. Like all the rails, it is ſo obſtinately averſe to riſe, that the ſportſman often ſeizes it with his hand, or fells it with a ſtick. If it finds a buſh in its retreat, it climbs upon it, and from the top of its aſylum beholds the dogs bruſhing along in fault: this habit is common to it and to the water-rail. It dives, ſwims, and even ſwims under water, when hard puſhed.

"Theſe birds diſappear in the depth of winter, but return early in the ſpring; and even in the month of February they are common in ſome provinces of France and Italy. Their fleſh is delicate, and much eſteemed: thoſe, in particular, which are caught in the rice-fields in Piedmont are very fat, and of an exquiſite flavour."

3. The crex, crake, or corn-crek, has been ſuppoſed by ſome to be the ſame with the water-rail, and that it differs only by a change of colour at a certain ſeaſon of the year: this error is owing to inattention to their characters and nature, both which differ entirely. The bill of this ſpecies is ſhort, ſtrong, and thick; formed exactly like that of the water-hen, and makes a generical diſtinction. It never frequents watery places; but is always found among corn, graſs, broom, or furze. It quits Britain before winter; but the water-rail endures their ſharpeſt ſeaſons. They agree in their averſion to flight; and the legs, which are remarkably long for the ſize of the bird, hang down whilſt they are on the wing; they truſt their ſafety to their ſwiftneſs on foot, and ſeldom are ſprung a ſecond time but with great difficulty. The land rail lays from 12 to 20 eggs, of a dull white colour, marked with a few yellow ſpots; notwithſtanding this, they are very numerous in that kingdom. Their note is very ſingular; and like the quail, it is decoyed into a net by the imitation of its cry, *crĕk crĕk crĕk*, by rubbing hard the blade of a knife on an indented bone. Moſt of the names given in different languages to this bird are evidently formed to imitate this ſingular cry. Hence Turner and ſome other naturaliſts have ſuppoſed it to be the crex of the ancients; but that term appears to have been applied by the ancients to other birds. Philus gives the crex the epithet of βραδαπτερος, or *ſluggiſh-winged*, which would indeed ſuit the land-rail. Ariſtophanes repreſents it as migrating from Lybia: Ariſtotle ſays that it is quarrelſome, which may have been attributed to it from the analogy to the quail; but he adds, that the crex ſeeks to deſtroy the neſts of the blackbird, which cannot apply to the rail, ſince it never inhabits the woods. Still leſs is the crex of Herodotus a rail, for he compares its ſize to that of the ibis, which is ten times larger. The avoſet, too, and the teal, have ſometimes the cry *crex, crex*: and the bird which Belon heard repeating that cry on the banks of the Nile is, according to his account, a ſpecies of godwit. Thus the ſound repreſented by the word *crex*, belonging to ſeveral ſpecies, is not ſufficiently preciſe to diſtinguiſh the land-rail.

Rallus
||
Ram.

They are in greateſt plenty in Angleſea, where they appear about the 20th of April, ſuppoſed to paſs over from Ireland, where they abound: at their firſt arrival it is common to ſhoot ſeven or eight in a morning. They are found in moſt of the Hebrides, and the Orkneys. On their arrival they are very lean, weighing only ſix ounces; but before they leave that iſland, grow ſo fat as to weigh above eight. The feathers on the crown of the head and hind-part of the neck are black, edged with bay colour: the coverts of the wings of the ſame colour, but not ſpotted; the tail is ſhort, and of a deep bay: the belly white; the legs aſh-coloured.

RALPH (James), a late ingenious hiſtorical and political writer, was born, we know not when or where, being firſt known as a ſchoolmaſter in Philadelphia in North America. He went to England about the beginning of the reign of George I. and wrote ſome things in the dramatic way, which were not received with great applauſe: but though he did not ſucceed as a poet, he was a very ingenious proſe-writer. He wrote A Hiſtory of England, commencing with the Stuarts, which is much eſteemed; as were his political eſſays and pamphlets, ſome of which were looked upon as maſter-pieces. His laſt publication, The Caſe of Authors by Profeſſion, is an excellent and entertaining performance. He died in 1762.

RAM, in zoology. See OVIS.

Battering RAM, in antiquity, a military engine uſed to

(A) 'I tried (ſays M. de Querhoent) to raiſe ſome: they thrived wonderfully at firſt, but after a fortnight's confinement their long legs grew paralytic, and the birds could only crawl on their knees; at laſt they expired.' Geſner ſays, that having long fed one, he found it to be peeviſh and quarrelſome."

to batter down the walls of beſieged places. See *Battering Ram*.

Ram's Head, in a ſhip, is a great block belonging to the fore and main haulyards. It has three ſhives in it, in which the haulyards are put; and in a hole at the end are reeved the ties.

RAMADAN, a ſolemn ſeaſon of faſting among the Mahometans. See Mahometanism.

RAMAH (anc. geog.), a town of Benjamin, near Gibea, (Judges); called *Rama of Saul* (1 Sam. xxii.), ſix miles from Jeruſalem to the north; memorable for the ſtory of the Levite and his concubine: Taken and fortified by Baaſa king of Iſrael, in order to annoy the kingdom of Judah. This Rama is mentioned Iſa. x. Jer. xxxi. and Matth. ii. and is to be diſtinguiſhed from *Rama of Samuel*, 1 Sam. xix. called alſo *Ramatha*, 1 Sam. i. 19. and *Ramathaim Zophim*, ibid. i. 1. which lay a great way to the weſt, towards Joppa, near Lydda, 1 Maccab. ii. the birth-place of Samuel; adjoining to the mountains of Ephraim, and the place of his reſidence, 1 Sam. xv. &c. (Joſephus). Called *Ramula* in the lower age, (Gul. Tyrius.) There is here a convent of the Fathers of the Holy Land, inhabited only by Portugueſe, Spaniards, and Italians.

RAMATH-mizpe, (Joſhua xiii.); *Ramoth-Maſphe*, (Septuagint, Vulgate); *Ramoth in Gilead*, or *Remmath Galaad*, (Seventy); a town in that tract of Gilead called *Maſpha*, or *Mizpe*, one of the cities of refuge.

RAMAZZINI (Bernardin), an Italian phyſician, born at Carpi near Modena in 1633. He was profeſſor of phyſic in the univerſity of Modena for 18 years; and in 1700 accepted an invitation from Padua, where he was made rector of the college; and died in 1714. His works were collected and publiſhed in London, 1716; of which, his treatiſe *De Morbis Artificium*, "Of the peculiar maladies of artificers," will always be eſteemed uſeful and curious.

RAMEKINS, a fortreſs of the United Netherlands, on the ſouth coaſt of the iſland of Walchevin, in the province of Zeland. One of the cautionary towns given to Queen Elizabeth for the repayment of the charges ſhe had been at for the defence of this republic in its infancy. Four miles eaſt of Fluſhing; in N. Lat. 51. 34. E. Long. 4. 24.

RAMESES, (anc. geog.); a town built by the Iſraelites during their bondage in Egypt, and from which the Exodus took place, and which muſt have been towards and not far from the Arabian Gulph, ſeeing in the third ſtation the Iſraelites arrived on its ſhore.

RAMESES, king of the Lower Egypt when Jacob went thither with his family, in the 1706th year before the Chriſtian era. Ancient authors mention ſeveral other kings of Egypt of the ſame name; and it is thought that one of thoſe princes erected in the temple of the ſun at Thebes, the magnificent obeliſk which the emperor Conſtantine cauſed to be removed to Alexandria in the year 334; and that prince dying, his ſon Conſtantius had the obeliſk tranſported from Alexandria to Rome in 352; where it was erected in the grand Circus. Its height was 132 feet. When the Goths ſacked the city of Rome in 409, they overthrow this obeliſk, which continued buried in the ſand till the time of Sixtus V. in 1587, when it was found broken in three pieces; which being joined together, it was ſet up in the ſquare of St John de Lateran. On the four ſides of this wonderful obeliſk are a number of figures and hieroglyphical characters, which, according to the explication of Ammianus Marcellinus, contain the praiſes of Rameſes.

RAMIFICATION, the production of boughs or branches, or of figures reſembling branches.

RAMILLIES, a ſmall village of Brabant, in the Auſtrian Low Countries, 12 miles north of Namur, and 22 ſouth-eaſt of Bruſſels. Lat. 50. 51. Long. 4. 48. Famous for the battle fought by the allies commanded by the duke of Marlborough and M. D'Auverquirque, againſt that of the two crowns, commanded by the Duke of Bavaria and Marſhal Villeroy, the 22d of May 1706. See Britain, nº 357.

The troops deſtined to compoſe the army of the allies being joined at the camp of Borchloon the 20th of May, halted the 21ſt. On the 22d the army marched from Borchloon in four columns, and poſted itſelf the ſame day, with the right towards the Mill of Quorem, extending with the left towards Blehen: from this camp was diſcovered the army of the two crowns, which was encamped with the left at Over-Eſpen, and the right towards the wood of Chapiaraux, Heyliſſem in their front, and Tirlemont in their rear. It was reſolved the ſame day to march the next morning towards the plain of Meerdorp or Mierdau, to view the poſture of the enemies, and determine what would be the moſt proper means of attacking them according to the movement they ſhould make. To this end, an advanced guard of 600 horſe and all the quarter-maſters of the army were ſent forward on the 23d at break of day.

The ſame morning about four, the army marched in eight columns towards the aforeſaid plain. The advanced guard and the quarter-maſters arrived about eight at the height of Meerdorp or Mierdau; from whence the army of the enemy was ſeen in motion: a little after it was perceived that the enemy was marching through the plain of Mount St Andrew in four columns, of which information was given to the duke of Marlborough and M. D'Auverquirque, who immediately repaired to the ſaid height; and by the time theſe generals were arrived there, the head of the enemy's army already appeared at the tomb of Ottomont upon the cauſeway, near the Mehaigne: whereupon the Duke of Marlborough and M. D'Auverquirque made the army advance with all expedition.

The enemy, as faſt as they advanced, ranged in order of battle, with their right towards the tomb of Ottomont upon the Mehaigne, extending with their left to Autr' Egliſe; having Tranquiers in front of their right, into which they had thrown ſeveral battalions of infantry and 14 ſquadrons of dragoons, who had diſmounted their horſes to ſupport them. They had placed many of their infantry and a conſiderable part of their artillery in the village of Ramillies, which fronted the right of their main body, as well as into the village of Offuz, which fronted the left of their infantry, and into the village of Autr' Egliſe, quite on their left. The front between the village of Ramillies and Autr'Egliſe was covered by a ſmall ſtream of water, which rendered the meadows in ſome places marſhes, and alſo by ſeveral roads covered with hedges; which difficulties prevented the allied cavalry of the right wing from coming to action. As faſt as the army of the allies arrived it was ranged in order of battle; with the left towards

Bonneſ,

Bonnef, and the right towards Foltz, and every thing was diſpoſed in order to attack. To this end, four battalions were detached to attack the village of Franquenies, and twelve battalions to attack the village of Ramillies, which were to be ſupported by the whole infantry.

The artillery began to cannonade the enemy at one; at about two, the attack began with the poſt of Franquenies, where the infantry had the good fortune to drive the enemy from the hedges, where they were advantageouſly poſted, and at the ſame time all the cavalry of the left wing advanced to attack that of the enemy's right; ſoon after all was in action. Whilſt the cavalry were engaged, the village of Ramillies was likewiſe attacked, and forced after a vigorous reſiſtance.

The battle laſted about two hours, and was pretty obſtinate; but ſo ſoon as the allied cavalry had gained ground enough to attack the enemy in flank, they began to give way; at the ſame time all their infantry were put in diſorder, ſo that the whole retreated in great confuſion. The cavalry of their left wing formed a little upon the high ground, between Offuz and Mount St Andrew, to favour their retreat: but after the infantry and cavalry of the right wing of the allies had filed off between the bottom of the village of Ramillies and Offuz, the whole army marched in ſeveral columns to attack the enemy anew; but they gave way before the allies could come up with them, and retired in great confuſion, ſome towards the defile of the Abbey De La Ramée and towards Dongelberge, others towards Judogne, and others again towards Hougarde. They were purſued all night ſo cloſely that they were obliged to abandon all their artillery and baggage, part of which was found at Judogne and at Hougarde, with their cheſts of ammunition.

The enemy loſt above 30,000 men, 60 cannon, 8 mortars, ſtandards, colours, baggage, &c. the allies about 3000. The reſt of the campaign was ſpent in the ſieges of Oſtend, Menin, and Aeth. In fourteen days the Duke defeated and diſperſed the beſt appointed army the French ever had, and recovered all Spaniſh Brabant, the marquiſate of the holy Roman empire. The army of the enemy conſiſted of 76 battalions and 142 ſquadrons, including the king's houſehold troops *(La Maiſon du Roi)*; and the army of the allies was 74 battalions and 123 ſquadrons. Conſidering the importance of the victory, the loſs of the allies was very ſmall, not above 1100 being killed, and 2600 wounded.

RAMLA, the modern name of Arimathea. See Arimathea.

RAMMER, an inſtrument uſed for driving down ſtones or piles into the ground; or for beating the earth, in order to render it more ſolid for a foundation.

Rammer of a Gun, the *Gun-ſtick*; a rod uſed in charging of a gun, to drive home the powder, as alſo the ſhot, and the wad which keeps the ſhot from rolling out.

RAMPANT, in heraldry, a term applied to a lion, leopard, or other beaſt that ſtands on its hind legs, and rears up his fore-feet in the poſture of climbing, ſhowing only half his face, as one eye, &c. It is different from ſaliant, in which the beaſt ſeems ſpringing forward as if making a ſally.

RAMPART, in fortification, is an elevation of earth round a place capable of reſiſting the cannon of an enemy; and formed into baſtions, curtains, &c.

RAMPHASTOS, the Toucan, in ornithology. See Rhamphastos.

RAMSAY (Allan), the Scots paſtoral poet, was a barber in Edinburgh in the early part of the preſent century. His taſte in poetry, however, has juſtly raiſed him to a degree of fame that may in ſome meaſure be conſidered as a recompenſe for the frowns of fortune. His ſongs are in univerſal eſteem; as is alſo the only dramatic performance attributed to him, viz. *Patie and Roger*, or *The Gentle Shepherd*, a Scots paſtoral. He died in 1743; and was father to the ingenious Mr Ramſay, a celebrated painter of the preſent age, and who has likewiſe diſtinguiſhed himſelf by ſome well-written tracts on various branches of polite literature, particularly the *Inveſtigator*.

Ramsay (Andrew Michael), generally known by the name of the *Chevalier Ramſay*, was a polite Scots writer, born of a good family at Ayr in 1686. His good parts and learning recommended him to be tutor to the ſon of the earl of Wemyſs; after which, conceiving a diſguſt at the religion in which he had been educated, he in the ſame ill humour reviewed other Chriſtian churches; and, finding none to his liking, reſted for a while in Deiſm. While he was in this uncertain ſtate of mind, he went to Leyden; where, falling into the company of one Poiret a myſtic divine, he received the infection of myſticiſm: which prompted him to conſult M. Fenelon, the celebrated archbiſhop of Cambray, who had imbibed principles of the ſame nature; and who gained him over to the Catholic religion in 1709. The ſubſequent courſe of his life received its direction from his friendſhip and connections with this prelate; and being appointed governor to the duke de Chateau Thierry, and the prince de Turenne, he was made a knight of the order of St Lazarus. He was ſent for to Rome by the chevalier de St George, to undertake the education of his children; but he found ſo many intrigues and diſſenſions on his arrival there in 1724, that he obtained the Chevalier's leave to return to Paris. He died in 1743, in the office of intendant to the duke of Bouillon, prince de Turenne. The moſt capital work of his writing is the *Travels of Cyrus*, which has been ſeveral times printed in Engliſh.

Ramsay (the Reverend James), ſo juſtly celebrated for his philanthropy, was, on the 25th of July 1733, born at Fraſerſburgh, a ſmall town in the county of Aberdeen, North Britain. His deſcent was honourable, being, through his father, from the Ramſays of Melroſe in Banffſhire, and through his mother, from the Ogilvies of Purie in Angus. His parents were of characters the moſt reſpectable, but in circumſtances by no means affluent. From his earlieſt years he diſcovered a ſerious diſpoſition, and a ſtrong thirſt for knowledge; and after paſſing through the courſe of a Scotch grammar ſchool education, he was inclined to purſue the ſtudies requiſite to fit him for the profeſſion of a clergyman; an inclination with which the wiſhes of his mother, a woman of eminent piety, powerfully concurred. Several circumſtances, however, conſpired to divert him for a time from his favourite purſuit.

He was educated in the epiſcopal perſuaſion; and having been unhappy enough to loſe his father while yet very young, he found, upon his advancing towards the ſtate of manhood, that the joint fortunes of himſelf and his mother could not bear the expence of a regular education in either of the univerſities of Oxford or Cambridge, which he doubtleſs thought abſolutely neceſſary to one who aſpired to reſpectability in the church of England. Yielding therefore to neceſſity, he reſolved to ſtudy ſurgery and pharmacy; and was with this view bound apprentice to Dr Findlay, a phyſician (A) in Fraſerſburgh. But though obliged to reliquiſh for a time his ſavourite ſtudies, he did not think ignorance excuſable in a ſurgeon more than in a clergyman, or conceive that he could ever become eminent in the profeſſion in which circumſtances had placed him, merely by ſkill in ſetting a bone or compounding a medicine. He determined therefore, with the full approbation of his maſter, who very ſoon diſcovered his talents for literature, to make himſelf acquainted with at leaſt the outlines of the liberal arts and ſciences; and with this view he repaired in 1750 to the King's College and univerſity of Aberdeen, where he obtained one of the *burſaries* or *exhibitions* which are there annually beſtowed upon ſuch candidates for them as diſplay the moſt accurate knowledge of the Latin language. The ſmall ſum of five pounds, however (which none of theſe burſaries exceed), was ſtill inadequate to the expence of reſidence in college; but our young ſtudent was ſoon to obtain a more valuable exhibition, and to obtain it likewiſe by his own merit.

During the long vacation he returned to his maſter Dr Findlay, and was by him intruſted with a very deſperate caſe in ſurgery, of which his management may be ſaid to have laid the foundation of his future fortunes. A ſemale ſervant of one of the judges of the Court of Seſſion, who, when the court was not ſitting, reſided in the neighbourhood of Fraſerſburgh, had been ſo dreadfully gored by a bull, that hardly any hopes were entertained of her recovery; but Mr Ramſay, to whoſe care ſhe was entirely left, treated the wound with ſuch ſkilful attention, that, contrary to general expectation, his patient recovered. This attracted the judge's notice, who having informed himſelf of the young man's circumſtances and character, recommended him ſo effectually to Sir Alexander Ramſay of Balmain, that he preſented him with a burſary of 15 pounds a-year, which commenced at the next *ſeſſion* or *term*, in the ſame college.

He now proſecuted his ſtudies with comfort; and though he was detained in college a year longer than is uſual, being obliged, upon his acceptance of a ſecond burſary, to begin his courſe anew, he always conſidered this as a fortunate circumſtance, becauſe it gave him the celebrated Dr Reid three years for his preceptor. To that great and amiable philoſopher he ſo recommended himſelf by his talents, his induſtry, and his virtues, that he was honoured with his friendſhip to the day of his death. Nor was it only to his maſters that his conduct recommended him; Sir Alexander Ramſay, whom he viſited during ſome of the vacations, was ſo well pleaſed with his converſation, that he promiſed him another burſary, in his gift, of 25 l. a-year, to commence immediately on the expiration of that which he enjoyed. This promiſe he performed in the beginning of the year 1755; and at the ſolicitation of Dr Findlay even paid the money per advance to enable the exhibitioner to travel for the purpoſe of improving himſelf in his profeſſion.

Thus provided, Mr Ramſay went to London, and ſtudied ſurgery and pharmacy under the auſpices of Dr Macauly; in whoſe family he lived for two years, careſſed and eſteemed both by him and by his lady. Afterwards, having paſſed the uſual examination at Surgeon's-hall, he ſerved in his medical capacity for ſeveral years in the royal navy; but how long he was continued in the ſtation of a mate, or when and by whom he was firſt appointed ſurgeon, we have not been able to learn. We can ſay, however, upon the beſt authority, that by his humane and diligent diſcharge of his duty in either ſtation, he endeared himſelf to the ſeamen, and acquired the eſteem of his officers.

Of his humanity there is indeed one memorable inſtance, which muſt not be omitted. Whilſt he acted as ſurgeon of the Arundel, then commanded by Captain (now Vice-admiral Sir Charles) Middleton, a ſlave-ſhip on her paſſage from Africa to the Weſt Indies fell in with the fleet to which the Arundel belonged. An epidemical diſtemper, too common in ſuch veſſels, had ſwept away not only a great number of the unfortunate negroes, but alſo many of the ſhip's crew, and among others the ſurgeon. In this diſtreſſed ſituation the commander of the Guinea ſhip applied to the Engliſh Commodore for medical aſſiſtance; but not a ſurgeon or ſurgeon's mate in the whole fleet, except Mr Ramſay, would expoſe himſelf to the contagion of ſo dangerous a diſtemper. Prompted, however, by his own innate benevolence, and fully authorized by his no leſs benevolent commander, the ſurgeon of Arundel, regardleſs of perſonal danger, and truſting in that God to whom mercy is more acceptable than ſacrifice, went on board the infected ſhip, viſited all the patients, and remained long enough to leave behind him written directions for their future treatment. If a cup of cold water given in charity be entitled to a reward, how much more ſuch an action as this? But the rewards of Chriſtianity are not immediate. Mr Ramſay indeed eſcaped the contagion; but on his return to his own ſhip, juſt as he had got on the deck, he fell and broke his thigh-bone; by which he was confined to his apartment for ten months, and rendered in a ſmall degree lame through the remainder of his life.

The fearleſs humanity which he diſplayed on this occaſion gained him the friendſhip and eſteem of Sir Charles Middleton, which no future action of his life had the ſmalleſt tendency to impair; but the fracture of his thigh-bone and his ſubſequent lameneſs determined him to quit the navy, and once more turn his thoughts towards the church. Accordingly, while the Arundel lay at St Chriſtopher's, he opened his views to ſome

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(A) In the remote towns of Scotland the ſame man generally acts in the triple capacity of phyſician, ſurgeon, and apothecary; and we could mention doctors of phyſic of the firſt eminence, who practiſe thus within forty miles of Edinburgh.

ſome of the principal inhabitants of that iſland, by whom he was ſo ſtrongly recommended to the biſhop of London, that on his coming home with Sir Charles Middleton, who warmly joined in the recommendation, he was admitted into orders; after which he immediately returned to St Chriſtopher's, where he was preſented by the governor to two rectories, valued at 700 l. a-year.

As ſoon as he took poſſeſſion of his livings, in 1763, he married Miſs Rebecca Akers; the daughter of a planter of the beſt family-connections in the iſland, and began to regulate his houſehold on the pious plan inculcated in his *Eſſay on the Treatment and Converſion of the African Slaves in the Britiſh Sugar Colonies.* He ſummoned all his own ſlaves daily to the prayers of the family, when he took an opportunity of pointing out to them their duty in the plaineſt terms, reproving thoſe that had done amiſs, and commending ſuch as had ſhown any thing like virtue; but he confeſſed that his occaſions for reproof were more frequent than for commendation. As became his office and character, he inculcated upon others what he practiſed himſelf, and knew to be equally the duty of all. "On his firſt ſettlement as a miniſter in the Weſt Indies, he made ſome public attempts to inſtruct ſlaves. He began to draw up ſome eaſy, plain diſcourſes for their inſtruction. He invited them to attend on Sundays, at particular hours. He appointed hours at home to inſtruct ſuch ſenſible ſlaves as would of themſelves attend. He repeatedly exhorted their maſters to encourage ſuch in their attendance. He recommended the French cuſtom, of beginning and ending work by prayer. But inconceivable is the liſtleſſneſs with which he was heard, and bitter was the cenſure heaped on him in return. It was quickly ſuggeſted, and generally believed that he wanted to interrupt the work of ſlaves, to give them time, forſooth, to ſay their prayers; that he aimed at the making of them Chriſtians, to render them incapable of being good ſlaves. In one word, he ſtood, in opinion, a rebel convict againſt the intereſt and majeſty of planterſhip. And as the Jews ſay, that in every puniſhment, with which they have been proved, ſince the bondage of Egypt, there has been an ounce of the golden calf of Horeb; ſo might he ſay, that in every inſtance of prejudice (and they were not a few) with which, till within a year or two of his departure from the country, he was exerciſed, there was an ounce of his fruitleſs attempts to improve the minds of ſlaves. In the bidding prayer, he had inſerted a petition for the converſion of thoſe perſons. But it was deemed ſo diſagreeable a memento, that ſeveral white people, on account of it, left off attending divine ſervice. He was obliged to omit the prayer intirely, to try and bring them back. In ſhort, neither were the ſlaves, at that time, deſirous of being taught, nor were their maſters inclined to encourage them."

That he was hurt by this neglect cannot be queſtioned, for he had a mind benevolent, warm, and irritable; but he ſtill retained many friends amongſt the moſt worthy members of the community: and as he was conſcious of having done nothing more than his duty, he conſoled himſelf with reflecting, that thoſe are "bleſſed whom men revile, and perſecute, and ſpeak all manner of evil againſt falſely, for the ſake of the goſpel."

Although his ſerious ſtudies were now theological, he conſidered himſelf as anſwerable to God, his country, and his own family, for a proper uſe of every branch of knowledge which he poſſeſſed. He therefore took the charge of ſeveral plantations around him in the capacity of a medical practitioner; and attended them with unremitting diligence, and with great ſucceſs. Thus he lived till the year 1777, when relinquiſhing the practice of phyſic entirely, he paid a viſit to the place of his nativity, which he had not ſeen ſince 1755. His mother, whoſe latter days he had made comfortable by a handſome annuity, had been dead for ſome years; but he rewarded all who had been attentive to her, or in early life ſerviceable to himſelf; and he continued the penſion to a ſiſter who had a numerous family, for which her huſband was unable to provide.

After remaining three weeks in Scotland, and near a year in England, during which time he was admitted into the confidence of Lord George Germaine, ſecretary of ſtate for the American department, Mr Ramſay was appointed chaplain to Admiral Barrington, then going out to take a command in the Weſt Indies. Under this gallant officer, and afterwards under Lord Rodney, he was preſent at ſeveral engagements, where diſplayed a fortitude and zeal for the honour of his country which would not have diſgraced the oldeſt admiral. To the navy, indeed, he ſeems to have been ſtrongly attached; and he wrote, at an early period of his life, an *Eſſay on the Duty and Qualifications of a Sea-officer*, with ſuch a knowledge of the ſervice as would have done honour to the pen of the moſt experienced commander. Of the firſt edition of this eſſay the profits were by its benevolent author appropriated to the Magdalen and Britiſh lying-in hoſpitals, as thoſe of the ſecond and third (which laſt was publiſhed about the period of which we now write) were to the maritime ſchool, or, in the event of its failure, to the marine ſociety.

Although careſſed by both the admirals under whom he ſerved, and having ſuch influence with the latter as to be able to render eſſential ſervices to the Jews and other perſons whom he thought harſhly treated at the capture of St Euſtatius, Mr Ramſay once more quitted the ſea-ſervice, and retired to his paſtoral charge in the Iſland of St Chriſtopher's. There, however, though the former animoſities againſt him had entirely ſubſided, and though his friendſhip was now ſolicited by every perſon of conſequence in the iſland, he remained but a little while. Sick of the life of a planter and of the proſpect of ſlavery around him, he reſigned his livings, bade adieu to the iſland, and returned to England with his wife and family in the end of the year 1781. Immediately on his arrival, he was, through the intereſt of his ſteady friend Sir Charles Middleton, preſented to the livings of Teſton and Nettleſtead in the county of Kent.

Here he was ſoon determined, by the advice of thoſe whom he moſt reſpected, to publiſh an *Eſſay*, which had been written many years before, *on the Treatment and Converſion of African Slaves in the Britiſh Sugar Colonies*. The controverſy in which this publication involved him, and the acrimony with which it was carried on, are ſo freſh in the memory of all our readers, that no man who thinks of the narrow limits within which our biographical articles muſt be confined, will blame us for not entering into a detail of the particulars.—Torrents of obloquy were poured upon the benevolent author by writers who were unfair enough to conceal

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their names; and it muſt be confeſſed, that his replies abounded with ſarcaſms, which the moſt rational friends to the cauſe which he ſupported would not have been ſorry to ſee blotted from his pages. The provocation, however, which he received was great; and Mr Ramſay, though an amiable, virtuous, and pious man, had a warmth of temper, which, though not deſerving of praiſe, will be cenſured by none who reflect on the frailties of our common nature. That the particular calumnies propagated againſt him on this occaſion were wholly groundleſs, it is impoſſible to doubt, if we admit him to have been poſſeſſed of common underſtanding. When ſome years ago a ſtory was circulated, of Swift's having, when prebendary of Kilroot, been convicted before a magiſtrate of an attempt to commit a rape on the body of one of his pariſhioners, it was thought a ſufficient confutation of the calumny to put the retailer of it in mind, that the dean of St Patrick's, though deteſted by the moſt powerful faction in the kingdom, lampooned without dread, and with great ſeverity, the dean of Ferns for the very crime of which, had this anecdote been true, he muſt have been conſcious that all Ireland knew himſelf to be guilty? Such conduct cannot be reconciled to common ſenſe. Had Swift been a raviſher, though he might have been penitent, and reaſoned in general terms againſt giving way to ſuch licentious paſſions, he would never have ſatyriſed a *particular perſon* for the crime of which he himſelf ſtood convicted. In like manner, had Mr Ramſay been a tyrant to his own ſlaves, though he might have argued againſt ſlavery in the abſtract, on the broad baſis of virtue and religion, he never could have arraigned for ſimilar cruelty a number of individuals in the very iſland which witneſſed his own enormities.

But the melancholy part of the narrative is behind. The agitation given to his mind by theſe calumnies, and the fatigues he underwent in his endeavours to reſcue from miſery the moſt helpleſs portion of the human race, contributed to ſhorten a life in no common degree uſeful. He had been for ſome time afflicted with a pain in his ſtomach, for which he was prevailed upon, tho' with great reluctance, to try the effects of air and exerciſe, by attempting a journey of 100 miles. But in London, being ſeized with a violent vomiting of blood, he was unable either to proceed or to be removed home; and in the houſe of Sir Charles Middleton he ended his days, on the 20th of July 1789, amidſt the groans of his family, and the tears of many friends.—Thus died a man, of whom it is not too much to ſay, that "the bleſſing of many that were ready to periſh came upon him;" for whatever be the fate of the ſlave-trade (ſee SLAVERY), it is certain that his writings have contributed much to meliorate the treatment of ſlaves. He left behind him a widow and three daughters: and his works, beſides thoſe to which we have alluded, conſiſt of a volume of *Sea-ſermons*, preached on board his majeſty's ſhip the Prince of Wales, which ſhow him to have been a maſter of true pulpit-eloquence; and a *Treatiſe on Signals*, which was certainly written, and we think printed, though we know not whether it was ever publiſhed.

RAMSDEN's MACHINE *for Dividing* MATHEMATICAL INSTRUMENTS, is a late invention, by which theſe diviſions can be performed with exceeding great accuracy, ſuch as would formerly have been deemed incredible. On diſcovering the method of conſtructing this machine, its inventor, Mr Ramſden of Piccadilly, received 615 l. from the commiſſioners of longitude; engaging himſelf to inſtruct a certain number of perſons, not exceeding ten, in the method of making and uſing this machine from the 28th October 1775 to 28th October 1777: alſo binding himſelf to divide all octants and ſextants by the ſame engine, at the rate of three ſhillings for each octant, and ſix ſhillings for each braſs ſextant, with Nonius's diviſions to half minutes, for as long time as the commiſſioners ſhould think proper to let the engine remain in his poſſeſſion. Of this ſum of 615 l. paid to Mr Ramſden, 300 l. was given him as a reward for the improvement made by him in diſcovering the engine, and the remaining 315 l. for his giving up the property of it to the commiſſioners. The following deſcription of the engine, is that given upon oath by Mr Ramſden himſelf.

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" This engine conſiſts of a large wheel of bell-metal, ſupported on a mahogany ſtand, having three legs, which are ſtrongly connected together by braces, ſo as to make it perfectly ſteady. On each leg of the ſtand is placed a conical friction-pulley, whereon the dividing-wheel reſts: to prevent the wheel from ſliding off the friction-pulleys, the bell-metal centre under it turns in a ſocket on the top of the ſtand.

" The circumference of the wheel is ratched or cut (by a method which will be deſcribed hereafter) into 2160 teeth, in which an endleſs ſcrew acts. Six revolutions of the ſcrew will move the wheel a ſpace equal to one degree.

" Now a circle of braſs being fixed on the ſcrew arbor, having its circumference divided into 60 parts, each diviſion will conſequently anſwer to a motion of the wheel of 10 ſeconds, ſix of them will be equal to a minute, &c.

" Several different arbors of tempered ſteel are truly ground into the ſocket in the centre of the wheel. The upper parts of the arbors that ſtand above the plane are turned of various ſizes, to ſuit the centres of different pieces of work to be divided.

" When any inſtrument is to be divided, the centre of it is very exactly fitted on one of theſe arbors; and the inſtrument is fixed down to the plane of the dividing wheel, by means of ſcrews, which fit into holes made in the radii of the wheel for that purpoſe.

" The inſtrument being thus fitted on the plane of the wheel, the frame which carries the dividing-point is connected at one end by finger-ſcrews with the frame which carries the endleſs ſcrew; while the other end embraces that part of the ſteel arbor, which ſtands above the inſtrument to be divided, by an angular notch in a piece of hardened ſteel; by this means both ends of the frame are kept perfectly ſteady and free from any ſhake.

" The frame carrying the dividing-point, or tracer, is made to ſlide on the frame which carries the endleſs ſcrew to any diſtance from the centre of the wheel as the radius of the inſtrument to be divided may require, and may be there faſtened by tightening two clamps; and the dividing-point or tracer being connected with the clamps by the double-jointed frame, admits a free and eaſy motion towards or from the centre for cutting the diviſions, without any lateral ſhake.

" From what has been ſaid, it appears, that an in-

Ramſden's Machine.

ſtrument thus fitted on the dividing-wheel may be moved to any angle by the ſcrew and divided circle on its arbor, and that this angle may be marked on the limb of the inſtrument with the greateſt exactneſs by the dividing-point or tracer, which can only move in a direct line tending to the centre, and is altogether freed from thoſe inconveniences that attend cutting by means of a ſtraight edge. This method of drawing lines will alſo prevent any error that might ariſe from an expanſion or contraction of the metal during the time of dividing.

"The ſcrew-frame is fixed on the top of a conical pillar, which turns freely round its axis, and alſo moves freely towards or from the centre of the wheel, ſo that the ſcrew-frame may be entirely guided by the frame which connects it with the centre: by this means any excentricity of the wheel and the arbor would not produce any error in the dividing; and, by a particular contrivance (which will be deſcribed hereafter), the ſcrew when preſſed againſt the teeth of the wheel always moves parallel to itſelf; ſo that a line joining the centre of the arbor and the tracer continued, will always make equal angles with the ſcrew.

Plate ccccxxxiii. "Figure 1. repreſents a perſpective view of the engine.

Plate ccccxxxiv. "Fig. 2. is a plan, of which fig. 3. repreſents a ſection on the line ΠΛ.

"The large wheel A is 45 inches in diameter, and has ten radii, each being ſupported by edge-bars, as repreſented in fig. 3. Theſe bars and radii are connected by the circular ring B, 24 inches in diameter and 3 deep; and, for greater ſtrength, the whole is caſt in one piece in bell-metal.

"As the whole weight of the wheel A reſts on its ring B, the edge-bars are deepeſt where they join it; and from thence their depth diminiſhes, both towards the centre and the circumference, as repreſented in fig. 3.

"The ſurface of the wheel A was worked very even and flat, and its circumference turned true. The ring C, of fine braſs, was fitted very exactly on the circumference of the wheel; and was faſtened thereon with ſcrews, which, after being ſcrewed as tight as poſſible, were well rivetted. The face of a large chuck being turned very true and flat in the lath, the flattened ſurface A of the wheel was faſtened againſt it with holdfaſts; and the two ſurfaces and circumference of the ring C, a hole through the centre and the plane part round (b) it, and the lower edge of the ring B, were turned at the ſame time. Fig. 3.

"D is a piece of hard bell-metal, having the hole, which receives the ſteel-arbor (d), made very ſtraight and true. This bell-metal was turned very true on an arbor; and the face, which reſts on the wheel at (b), was turned very flat, ſo that the ſteel arbor (d) might ſtand perpendicular to the plane of the wheel: this bell-metal was faſtened to the wheel by ſix ſteel ſcrews (l).

"A braſs ſocket Z is faſtened on the centre of the mahogany ſtand, and receives the lower part of the bell-metal piece D, being made to touch the bell-metal in a narrower part near the mouth, to prevent any obliquity of the wheel from bending the arbor: good fitting is by no means neceſſary here; ſince any ſhake in this ſocket will produce no bad effect, as will appear hereafter when we deſcribe the cutting frame.

Ramſden's Machine.

Fig. 1, 2, and 3. "The wheel was then put on its ſtand, the lower edge of the ring B reſting on the circumference of three conical friction-pulleys W, to facilitate its motion round its centre. The axis of one of theſe pulleys is in a line joining the centre of the wheel and the middle of the endleſs ſcrew, and the other two placed ſo as to be at equal diſtances from each other.

Fig. 1. "F is a block of wood ſtrongly faſtened to one of the legs of the ſtand; the piece (g) is ſcrewed to the upper ſide of the block, and has half holes, in which the tranſverſe axis (h) turns: the half holes are kept together by the ſcrews (i). Fig. 4.

Fig. 1. & 4. "The lower extremity of the conical pillar P terminates in a cylindrical ſteel-pin (k), which paſſes through and turns in the tranſverſe axis (h), and is confined by a cheek and ſcrew. Fig. 4.

"To the upper end of the conical pillar is faſtened the frame G, in which the endleſs ſcrew turns: the pivots of the ſcrew are formed in the manner of two fruſtums of cones joined by a cylinder, as repreſented at X. Theſe pivots are confined between half poles, which preſs only on the conical parts, and do not touch the cylindric parts: the half holes are kept together by ſcrews (a), which may be tightened at any time, to prevent the ſcrew from ſhaking in the frame. Fig. 4. Fig. 5.

Fig. 1, 2, 4, 5. "On the ſcrew-arbor is a ſmall wheel of braſs K, having its outſide edge divided into 60 parts, and numbered at every 6th diviſion with 1, 2, &c. to 10. The motion of this wheel is ſhown by the index (y) on the ſcrew-frame G. Fig. 4. & 5.

Fig. 1. "H repreſents a part of the ſtand, having a parallel ſlit in the direction towards the centre of the wheel, large enough to receive the upper part of the conical braſs pillar P, which carries the ſcrew and its frame: and as the reſiſtance, when the wheel is moved by the endleſs ſcrew, is againſt that ſide of the ſlit H which is towards the left hand, that ſide of the ſlit is faced with braſs, and the pillar is preſſed againſt it by a ſteel ſpring on the oppoſite ſide: by this means the pillar is ſtrongly ſupported laterally, and yet the ſcrew may be eaſily preſſed from or againſt the circumference of the wheel, and the pillar will turn freely on its axis to take any direction given it by the frame L.

Fig. 4. "At each corner of the piece I are ſcrews (n) of tempered ſteel, having poliſhed conical points: two of them turn in conical holes in the ſcrew-frame near (o), and the points of the other two ſcrews turn in holes in the piece Q; the ſcrews (p) are of ſteel, which being tightened, prevent the conical pointed ſcrews from unturning when the frame is moved.

Fig. 1, 2, 6. "L is a braſs frame, which ſerves to connect the endleſs ſcrew, its frame, &c. with the centre of the wheel: each arm of this frame is terminated by a ſteel ſcrew, that may be paſſed through any of the holes (q) in the piece Q, as the thickneſs of work to be divided on the wheel may require, and are faſtened by the finger-nuts (r). Fig. 4. Fig. 1. & 2.

Fig. 6. "At the other end of this frame is a flat piece of tempered ſteel (b), wherein is an angular notch: when the endleſs ſcrew is preſſed againſt the teeth on the circumference of the wheel, which may be done by turning the finger ſcrew S, to preſs againſt the ſpring (t), this Fig. 1. & 2.

Ramſden's Machine. this notch embraces and preſſes againſt the ſteel arbor (d). This end of the frame may be raiſed or depreſſed Fig. 2. by moving the priſmatic ſlide (u), which may be fixed Fig. 1, 2, 6. at any height by the four ſteel-ſcrews (v).

Fig. 1 & 6. "The bottom of this ſlide has a notch (k), whoſe plane is parallel to the endleſs-ſcrew; and by the point of Fig. 3. the arbor (d) reſting in this notch, this end of the frame is prevented from tilting. The ſcrew S is pre- Fig. 1, 2. vented from unturning, by tightening the fingernut (w).

"The teeth on the circumference of the wheel were cut by the following method:

"Having conſidered what number of teeth on the circumference would be moſt convenient, which in this engine is 2160, or 360 multiplied by 6, I made two ſcrews of the ſame dimenſions, of tempered ſteel, in the manner hereafter deſcribed, the interval between the threads being ſuch as I knew by calculation would come within the limits of what might be turned off the circumference of the wheel: one of theſe ſcrews, which was intended for ratching or cutting the teeth, was notched acroſs the threads, ſo that the ſcrew, when preſſed againſt the edge of the wheel and turned round, cut in the manner of a ſaw. Then having a ſegment of a circle a little greater than 60 degrees, of about the ſame radius with the wheel, and the circumference made true, from a very fine centre, I deſcribed an arch near the edge, and ſet off the chord of 60 degrees on this arch. This ſegment was put in the place of the wheel, the edge of it was ratched, and the number of revolutions and parts of the ſcrew contained between the interval of the 60 degrees were counted. The radius was corrected in the proportion of 360 revolutions, which ought to have been in 60 degrees, to the number actually found; and the radius, ſo corrected, was taken in a pair of beam-compaſſes: while the wheel was on the lath, one foot of the compaſſes was put in the centre, and with the other a circle was deſcribed on the ring; then half the depth of the threads of the ſcrew being taken in dividers, was ſet from this circle outwards, and another circle was deſcribed cutting this point; a hollow was then turned on the edge of the wheel of the ſame curvature as that of the ſcrew at the bottom of the threads: the bottom of this hollow was turned to the ſame radius or diſtance from the centre of the wheel, as the outward of the two circles beforementioned.

"The wheel was now taken off the lath; and the Fig. 3. bell-metal piece D was ſcrewed on as before directed, which after this ought not to be removed.

"From a very exact centre a circle was deſcribed Fig. 1, 2, 3. on the ring C, about $\frac{4}{10}$ of an inch within where the bottom of the teeth would come. This circle was divided with the greateſt exactneſs I was capable of, firſt into five parts, and each of theſe into three. Theſe parts were then biſected four times: (that is to ſay) ſuppoſing the whole circumference of the wheel to contain 2160 teeth, this being divided into five parts, each would contain 432 teeth; which being divided into three parts, each of them would contain 144; and this ſpace biſected four times would give 72, 36, 18, and 9: therefore each of the laſt diviſions would contain nine teeth. Ramſden's Machine. But, as I was apprehenſive ſome error might ariſe from quinqueſection and triſection, in order to examine the accuracy of the diviſions, I deſcribed another circle on the ring C, $\frac{1}{10}$ inch within the former, and divided it Fig. 7. by continual biſections, as 2160, 1080, 540, 270, 135, 67½, and 33¾; and as the fixed wire (to be deſcribed preſently) croſſed both the circles, I could examine their agreement at every 135 revolutions; (after ratching, could examine it at every 33¾): but, not finding any ſenſible difference between the two ſets of diviſions, I, for ratching, made choice of the former; and, as the coincidence of the fixed wire with an interſection could be more exactly determined than with a dot or diviſion, I therefore made uſe of interſections in both circles before deſcribed.

"The arms of the frame L were connected by a thin Fig. 7. piece of braſs of ¼ of an inch broad, having a hole in the middle of $\frac{4}{10}$ of an inch in diameter; acroſs this hole a ſilver wire was fixed exactly in a line to the centre of the wheel; the coincidence of this wire with the interſections was examined by a lens $\frac{7}{10}$ inch focus, fixed in a tube which was attached to one of the arms L (A). Now a handle or winch being fixed on the end of the ſcrew, the diviſion marked 10 on the circle K was ſet to its index, and, by means of a clamp and adjuſting ſcrew for that purpoſe, the interſection marked 1 on the circle C was ſet exactly to coincide with the fixed wire; the ſcrew was then carefully preſſed againſt the circumference of the wheel, by turning the finger-ſcrew S; then, removing the clamp, I turned the ſcrew by its handle 9 revolutions, till the interſection marked 240 came nearly to the wire; then, unturning the finger-ſcrew S, I releaſed the ſcrew from the wheel, and turned the wheel back till the interſection marked 2 exactly coincided with the wire, and, by means of the clamp beforementioned, the diviſion 10 on the circle being ſet to its index, the ſcrew was preſſed againſt the edge of the wheel by the finger-ſcrew S; the clamps were removed, and the ſcrew turned nine revolutions till the interſection marked 1 nearly coincided with the fixed wire; the ſcrew was releaſed from the wheel by unturning the finger-ſcrew S as before, the wheel was turned back till the interſection 3 coincided with the fixed wire; the diviſion 10 on the circle being ſet to its index, the ſcrew was preſſed againſt the wheel as before, and the ſcrew was turned 9 revolutions, till the interſection 2 nearly coincided with the fixed wire, and the ſcrew was releaſed; and I proceeded in this manner till the teeth were marked round the whole circumference of the wheel. This was repeated three times round, to make the impreſſion of the ſcrew deeper. I then ratched the wheel round continually in the ſame direction without ever diſengaging the ſcrew; and, in ratching the wheel about 300 times round, the teeth were finiſhed.

"Now it is evident, if the circumference of the wheel was even one tooth or ten minutes greater than the ſcrew would require, this error would in the firſt inſtance

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(A) The interſections are marked for the ſake of illuſtration, though properly inviſible, they lying under the braſs plate.

ſtance be reduced to $\frac{1}{24}$ part of a revolution, or two ſeconds and a half; and theſe errors or inequalities of the teeth were equally diſtributed round the wheel at the diſtance of nine teeth from each other. Now, as the ſcrew in ratching had continually hold of ſeveral teeth at the ſame time, and, theſe conſtantly changing, the abovementioned inequalities ſoon corrected themſelves, and the teeth were reduced to a perfect equality. The piece of braſs which carries the wire was now taken away, and the cutting ſcrew was alſo removed, and a plain one (hereafter deſcribed) put in its place: on one end of the ſcrew is a ſmall braſs circle, having its edge divided into 60 equal parts, and numbered at every ſixth diviſion, as beforementioned. On the other end of the ſcrew is a ratchet-wheel C, having 60 teeth, Fig. 5. covered by the hollowed circle (d), which carries two clicks that catch upon the oppoſite ſides of the ratchet when the ſcrew is to be moved forwards. The cylinder S turns on a ſtrong ſteel arbor F, which paſſes through and is firmly ſcrewed to the piece Y: this piece, for greater firmneſs, is attached to the ſcrew-Fig. 4. frame G by the braces (v): a ſpiral groove or thread is cut on the outſide of the cylinder S, which ſerves both for holding the ſtring, and alſo giving motion to the lever J on its centre by means of a ſteel tooth (n), that works between the threads of the ſpiral. To the lever is attached a ſtrong ſteel pin (m), on which a braſs ſocket (r) turns: this ſocket paſſes through a ſlit in the piece (p), and may be tightened in any part of the ſlit by the finger-nut (f): this piece ſerves to regulate the number of revolutions of the ſcrew for each tread of the treadle R.

Fig. 1. "T is a braſs box containing a ſpiral ſpring; a Fig. 1. ſtrong gut is faſtened and turned three or four times round the circumference of this box; the gut then paſſes ſeveral times round the cylinder S, and from thence down to the treadle R. Now, when the treadle is preſſed down, the ſtring pulls the cylinder S round its axis, and the clicks catching hold of the teeth on the ratchet carry the ſcrew round with it, till, by the tooth (n) working in the ſpiral groove, the lever J is Fig. 4. brought near the wheel (d), and the cylinder ſtopped by the ſcrew-head (x) ſtriking on the top of the lever J; at the ſame time the ſpring is wound up by the other end of the gut paſſing round the box T. Now, Fig. 1. when the foot is taken off the treadle, the ſpring unbending itſelf pulls back the cylinder, the clicks leaving the ratchet and ſcrew at reſt till the piece (t) ſtrikes on the end of the piece (p): the number of revolutions Fig. 1. of the ſcrew at each thread is limited by the number of revolutions the cylinder is allowed to turn back before the ſtop ſtrikes on the piece (p).

"When the endleſs ſcrew was moved round its axis with a conſiderable velocity, it would continue that motion a little after the cylinder S was ſtopped: to Fig. 1. & 4. prevent this, the angular lever ν was made; that when the lever J comes near to ſtop the ſcrew (x), it, by a ſmall chamfer, preſſes down the piece ν of the angular lever; this brings the other end λ of the ſame lever forwards, and ſtops the endleſs ſcrew by the ſteel pin μ ſtriking upon the top of it: the foot of the lever is raiſed again by a ſmall ſpring preſſing on the brace (v).

"D, two clamps, connected by the piece α, ſlide Fig. 1, 2, 6. one on each arm of the frame L, and may be fixed at pleaſure by the four finger-ſcrews ι, which preſs againſt ſteel ſprings to avoid ſpoiling the arms: the piece (q) is made to turn without ſhake between two conical pointed ſcrews (f), which are prevented from unturning by tightening the finger-nuts N.

Fig. 6. "The piece M is made to turn on the piece (q), by the conical pointed ſcrews (f) reſting in the hollow centers (e).

"As there is frequent occaſion to cut diviſions on inclined planes, for that purpoſe the piece γ, in which the tracer is fixed, has a conical axis at each end, which turn in half holes: when the tracer is ſet to any inclination, it may be fixed there by tightening the ſteel ſcrews β.

Deſcription of the Engine by which the endleſs ſcrew of the Dividing Engine was cut.

"Fig. 9. repreſents this engine of its full dimenſions ſeen from one ſide.

"Fig. 8. the upper ſide of the ſame as ſeen from above.

"A repreſents a triangular bar of ſteel, to which the triangular holes in the pieces B and C are accurately fitted, and may be fixed on any part of the bar by the ſcrews D.

"E is a piece of ſteel whereon the ſcrew is intended to be cut; which, after being hardened and tempered, has its pivots turned in the form of two fruſtums of cones, as repreſented in the drawings of the dividing engine (fig. 5.). Theſe pivots were exactly fitted to the half holes F and T, which were kept together by the ſcrews Z.

"H repreſents a ſcrew of untempered ſteel, having a pivot I, which turns in the hole K. At the other end of the ſcrew is a hollow centre, which receives the hardened conical point of the ſteel pin M. When this point is ſufficiently preſſed againſt the ſcrew, to prevent its ſhaking, the ſteel pin may be fixed by tightening the ſcrews Y.

"N is a cylindric nut, moveable on the ſcrew H; which, to prevent any ſhake, may be tightened by the ſcrews O. This nut is connected with the ſaddle-piece P by means of the intermediate univerſal joint W, through which the arbor of the ſcrew H paſſes. A front view of this piece, with a ſection acroſs the ſcrew arbor, is repreſented at X. This joint is connected with the nut by means of two ſteel ſlips S, which turn on pins between the cheeks T on the nut N. The other ends of theſe ſlips S turn in like manner on pins (a). One axis of this joint turns in a hole in the cock (b), which is fixed to the ſaddle-piece; and the other turns in a hole (d), made for that purpoſe in the ſame piece on which the cock (b) is fixed. By this means, when the ſcrew is turned round, the ſaddle-piece will ſlide uniformly along the triangular bar A.

"K is a ſmall triangular bar of well-tempered ſteel, which ſlides in a groove of the ſame form on the ſaddle-piece P. The point of this bar or cutter is formed to the ſhape of the thread intended to be cut on the endleſs ſcrew. When the cutter is ſet to take proper hold of the intended ſcrew, it may be fixed by tightening the ſcrew (e), which preſs the two pieces of braſs G upon it.

"Having meaſured the circumference of the dividing-wheel, I found it would require a ſcrew about one thread in a hundred coarſer than the guide-ſcrew H. The wheels on the guide-ſcrew arbor H, and that on the ſteel E, on which the ſcrew was to be cut, were proportioned to each other to produce that effect, by giving the wheel L 198 teeth, and the wheel Q 200. Theſe wheels communicated with each other by means of the intermediate wheel R, which alſo ſerved to give the threads on the two ſcrews the ſame direction.

"The ſaddle-piece P is confined on the bar A by means of the pieces (g), and may be made to ſlide with a proper degree of tightneſs by the ſcrews (n)."

For Ramſden's equatorial or portable obſervatory, ſee Optics, nº 102. and Astronomy, nº 504. See alſo a long account of an equatorial inſtrument made by Mr Ramſden by the direction of Sir George Shuckburgh in the Philoſophical Tranſactions for 1793, art. x. p. 67. In this inſtrument the circle of declinations is four feet in diameter, and may be obſerved nearly to a ſecond. The glaſs is placed between ſix pillars, which form the axis of the machine, and turn round by two pivots placed on two blocks of ſtone. See alſo Barometer.

RAMSEY, a town of Huntingdonſhire, 68 miles north of London, and 12 north-eaſt of Huntingdon. It is ſituated as it were in an iſland, being everywhere encompaſſed with fens, except on the weſt, where it is ſeparated from the *terra firma* by a cauſey for two miles. The neighbouring meers of Ramſey and Whitleſey, which are formed by the river Nyne, abound with fowl and fiſh, eſpecially eel and large pikes. It was once famous for a very rich abbey, part of the gatehouſe of which is ſtill ſtanding, and a neglected ſtatue of Ailwin; the epitaph of whoſe tomb, which is reckoned one of the oldeſt pieces of Engliſh ſculpture extant, ſtyles him "kinſman of the famous King Edward, alderman of all England; and the miraculous founder of this abbey." It was dedicated to St Dunſtan, and its abbots were mitred, and ſat in parliament; and ſo many kings of England were benefactors to it, that its yearly rents, ſays Camden, were 7000 l. The town was then called *Ramſey the Rich*; but by the diſſolution of the abbey it ſoon became poor, and even loſt its market for many years, till about 185 years ago it recovered it. It is held on Saturday, and is reckoned one of the moſt plentiful and cheapeſt in England. In the year 1721 a great number of Roman coins were found here, ſuppoſed to have been hid by the monks on ſome incurſion of the Danes. There is a charity ſchool in the town for poor girls. W. Long. 0. 19. N. Lat. 52. 26.

Ramsey, an iſland of ſouth Wales, on the coaſt of Pembrokeſhire, about two miles in length, and a mile and a half broad. Near it are ſeveral ſmall ones, known by the name of the *biſhop and his clerks*. It is four miles weſt of St David's, and 17 north-weſt of Milford haven. It belongs to the biſhopric of St David's, and was in the laſt age, ſays Camden, famous for the death of one Juſtinian, a moſt holy man, who retiring hither from Britanny, in that age rich in ſaints, and devoting himſelf entirely to God, lived a long while in ſolitude, and being at laſt murdered by his ſervant was enrolled among the martyrs. W. Long. 5. 20. N. Lat. 51. 55.

Ramsey, in the Iſle of Man, to the north, a moſt noted and ſpacious haven, in which the greateſt fleet may ride at anchor with ſafety enough from all winds but the north-eaſt, and in that caſe they need not be embayed. This town ſtanding upon a beach of looſe ſand, or ſhingle, is in danger, if not timely prevented, of being waſhed away by the ſea.

RAMSGATE, a ſea-port town of Kent, in the iſle of Thanet, five miles from Margate, where a very fine pier has been lately built for the ſecurity of ſhips that come into the harbour, being ſeated near the Downs, between the north and ſouth Foreland, 10 miles north-eaſt of Canterbury. The town is ſituated in the cove of a chalky cliff. It was formerly but an obſcure fiſhing village, but ſince the year 1688 has been improved and enlarged by a ſucceſsful trade to Ruſſia and the eaſt country. But what renders it moſt worthy of notice, and attracts multitudes of ſtrangers, is the new harbour, which is one of the moſt capacious in England, if not in Europe. It was begun in the year 1750, but delayed by various interruptions. It conſiſts of two piers; that to the eaſt is built wholly of Purbeck ſtone, and extends itſelf into the ocean near 800 feet before it forms an angle; its breadth on the top is 26 feet, including a ſtrong parapet wall, which runs along the outſide of it. The other to the weſt is conſtructed of wood as far as the low-water mark, but the reſt is of ſtone. The angles, of which there are five in each pier, conſiſt of 160 feet each, with octagones at the end of 60 feet diameter, leaving an entrance of 200 feet into the harbour, the depth of which admits of a gradual increaſe of 18 to 36 feet. E. Long. 1. 30. N Lat. 51. 22.

RAMTRUT, a deity worſhipped by the Ranazins of Hindoſtan, where he has a celebrated temple at Onor. He is repreſented as more reſembling a monkey than a man.

RAMUS, in general, denotes a branch of any thing, as of a tree, an artery, &c. In the anatomy of plants it means the firſt or lateral branches, which go off from the petiolum, or middle rib of a leaf. The ſubdiviſions of theſe are called *ſurculi;* and the final diviſions into the moſt minute of all, are by ſome called *capillamenta;* but both kinds are generally denominated *ſurculus*.

Ramus (Peter), was one of the moſt famous profeſſors of the 16th century. He was born in Picardy in 1515. A thirſt for learning prompted him to go to Paris when very young, and he was admitted a ſervant in the college of Navarre. Spending the day in waiting on his maſters, and the greateſt part of the night in ſtudy, he made ſuch ſurpriſing progreſs, that, when he took his maſter of arts degree, he offered to maintain a quite oppoſite doctrine to that of Ariſtotle. This raiſed him many enemies; and the two firſt books he publiſhed, *Inſtitutiones Dialecticæ*, and *Ariſtotelicæ Animadverſiones*, occaſioned great diſturbances in the univerſity of Paris: and the oppoſition againſt him was not a little heightened by his deſerting the Romiſh religion, and profeſſing that of the Reformed. Being thus forced to retire from Paris, he viſited the univerſities of Germany, and received great honours wherever he came. He returned to France in 1571, and loſt his life miſerably in the horrid maſſacre of St Bartholomew's day. He was a great orator, a man of univerſal learning, and endowed with very fine moral qualities.

ties. He publiſhed many books, which Teiſſier enumerates. Ramus's merit in his oppoſition to Ariſtotle, and his firmneſs in undermining his authority, is unqueſtionably great. But it has been doubted, and with much reaſon, whether he was equally ſucceſsful in his attempts after a new logical inſtitute. We have the following general outline of his plan in Dr Enfield's Hiſtory of Philoſophy. "Conſidering dialectics as the art of deducing concluſions from premiſes, he endeavours to improve this art, by uniting it with that of rhetoric. Of the ſeveral branches of rhetoric, he conſiders invention and diſpoſition as belonging equally to logic. Making Cicero his chief guide, he divides his treatiſe on dialectics into two parts, the firſt of which treats of the invention of arguments, the ſecond of judgments. Arguments he derives not only from what the Ariſtotelians call middle terms, but from any kind of propoſition, which, connected with another, may ſerve to prove any aſſertion. Of theſe he enumerates various kinds. Judgments he divides into axioms, or ſelf-evident propoſitions, and *dianoëa*, or deductions by means of a ſeries of arguments. Both theſe he divides into various claſſes; and illuſtrates the whole by examples from the ancient orators and poets.

"In the logic of Ramus, many things are borrowed from Ariſtotle, and only appear under new names; and many others are derived from other Grecian ſources, particularly from the dialogues of Plato, and the logic of the Stoics. The author has the merit of turning the art of reaſoning from the futile ſpeculations of the ſchools to forenſic and common uſe; but his plan is defective in confining the whole dialectic art to the ſingle object of diſputation, and in omitting many things, which reſpect the general culture of the underſtanding and the inveſtigation of truth. Notwithſtanding the defects of his ſyſtem, we cannot however, ſubſcribe to the ſevere cenſure which has been paſſed upon Ramus by Lord Bacon and others; for much is, we think, due to him for having with ſo much firmneſs and perſeverance aſſerted the natural freedom of the human underſtanding. The logic of Ramus obtained great authority in the ſchools of Germany, Great Britain, Holland, and France; and long and violent conteſts aroſe between his followers and thoſe of the Stagyrite, till his fame vaniſhed before that of Deſcartes."

RAN, in the old Engliſh writers, means open or public robbery, ſo manifeſt as not to be denied. Ran *dicitur operta rapina quæ negari non poteſt.* Lamb. 125. Leg. Canut. cap. 58. Hence it is now commonly ſaid of one who takes the goods of another injuriouſly and violently, that he has taken or ſnatched all he could *rap* and *ran*.

RANA, or RANULA. See RANULA.

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